THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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1906 Edition

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POWER SUPPLY IN THE LONDON AREA.

FOR another year we shall make no headway in regard to the supply of electric power in London, excepting such as may result from the more energetic efforts of the existing undertakers. The report of the Parliamentary Committee, which we reprint on another page to-day, gives the L.C.C. an invitation to come again next year with what it considers a more suitable scheme, points out the necessity for safeguarding the interests of the supply systems already established under Parliamentary sanction, and suggests the shelving for the time being of all other power proposals which have been brought forward affecting the county area.

The rejection of the Council's 1906 scheme will hardly have surprised anybody who has closely followed the report of the proceedings, but there will be general regret among electrical engineers and many London industrial firms that so much public money has again been squandered in further depriving the public of the additional cheap power supply that most of us admit is necessary if London is to retain anything like its present manufacturing and industrial standing. We all know how the high rents, rates, and wages are continually causing an exodus of industries from London; this position becomes worsened now that the Council has succeeded in delaying the power supply question for at least another twelve months.

The *Railway Gazette* several weeks ago contained an article which may help to emphasise the importance of centralising the supply of power to the railways in and about London, which must be electrified, as most people think, within the near future.

Taking the use per train-mile for trains of all companies at 15 units, the writer calculates that the total energy required to run the 1905 steam service within a radius of 30 miles of Charing Cross is about 550 millions of units, figures which must go near being doubled if electrification produces the stimulus to traffic on which all estimates insist.

The evidence before the Power Bills Committee has inured us to the magnificently great and the astoundingly minute in the way of figures, so we accept without criticism the probability that the electrified suburban tracks alone will swallow a thousand million units per annum. Vast differences, however, will result if, on the one hand, this energy is to be supplied from L.C.C. stations, such as Greenwich, where the capital cost per kilowatt is £26, and the (estimated) working cost per unit ·28d.; from an L.C.C. station of the type of the Battersea proposition, where one KW. is to cost £16 to install, and one unit ·21d. to deliver; or from a station like that proposed by the Administrative Co. in which the use of turbine units of 30,000 KW. was intended to reduce the capital cost to £7 per KW., and the working cost to ·12d.

On one thousand million units per annum the differences amount to £670,000 per annum for Greenwich, and

£380,000 per annum for Battersea. At 3½ per cent. these amounts capitalise to twenty millions and eleven millions of pounds respectively, enough to provide the Administrative Co. with nearly three millions of KW. in the first case and more than 1½ millions in the second.

These figures are so huge as to be grotesque, and we could wish for the sake of general credibility that they had been no more than one-tenth the size. The public will never believe that two sets of men drawn from the same profession and both trying to make out the best case for cheap power could differ by such monstrous amounts in their estimates. It will know nothing of the cheapening power of immense units, and it will take almost certainly the conservative side, although Mr. Merz has given just as good reasons for his faith as the others.

Even if the public does take to heart the apparently fabulous benefits offered by the Administrative Co., or by the other companies which are snatching at its cloak, will they not say, when primed by their municipal leaders, What is to prevent the L.C.C. doing just as well as any company now that the way has been made clear? Does not Greenwich sink to the significance, or the insignificance if you will, of a sub-station in comparison with the really modern station which the L.C.C. now knows how to build? What can the answer be but Yes! to both questions when asked of an audience which does not realise that if the station can be built for £7 per KW. and energy supplied from it for ·12d., the audience by the act of acknowledgment has itself indicted the L.C.C. for the most appalling financial and engineering blunder possible to conceive. What but Yes! from an audience which will not admit that nothing short of a revolution in English law can compel the railway companies to take electricity for all or any of their lines from the L.C.C.: the companies know that as large ratepayers they would have to pay the difference between the estimate and the actuality, just as they now have to pay for tramways and steamboats which compete with them.

What is to be expected in the future of a council which proposes to make such a blunder at the start either because it knows no better or because its financial difficulties are so pressing already that a modern scheme seemed out of the question? Confidence vanishes at once, and we look with weary eyes for the continued muddle, the everlasting coercive attempts, and the prevaricating accounts which are bound to follow.

How, for the sake of an idea, not false in itself but wrongly interpreted, men can condemn themselves, and millions of their fellows, to financial slavery; how, subjects themselves, they can build up on bureaucratic and tyrannical lines a system of compulsory economics, will serve as a pleasantly speculative theme for the philosophers of the next century.

Improved Methods in Regard to Railway Returns.

NOT content with securing powers to collect statistics as to the general conditions of internal trade, the Government have appointed a Committee to investigate the form and scope of the accounts and statistical returns. In regard to the first named (a desirable reform for which we had repeatedly pleaded in these columns), those responsible for the movement had one or both eyes on the necessity of securing fresh missiles should the next General Election be waged on fiscal issues. In regard to the new Committee on railway statistics, no ulterior motive can be ascribed.

It has been for a long while notorious that the Board of Trade railway returns were hopelessly inadequate, and would not compare for one minute in administrative or commercial value even with the returns of the electric tramways undertaking of a moderate sized municipality. Costs were worked out for different railways to the second place of decimals for the train-mile. A more illusory unit it is difficult to conceive. It covers everything, from heavy long-distance expresses, to light trains of three or four coaches dawdling on country branches, and from heavy mineral trains, whose mean "load factor" per vehicle would be about 50 per cent. for the time occupied in transit, to trains carrying miscellaneous produce in half-empty vehicles.

For a long time a school of statisticians, led by Mr. W. M. Acworth, have pleaded in the technical Press and at various engineering and scientific societies for reforms which should include passenger-mile and ton-mile statistics. The campaign has been one of marked moderation, and at last seems likely to be crowned with success.

The question is one likely to be of considerable importance to electrical engineers in the immediate future. The question of reform must not stop at ton-mile or passenger-mile statistics. The vehicle-mile unit is necessary. Speeds call for consideration, and passenger services should be classified as fast, slow and suburban. The relation of the weight of the train to the number of passengers carried, is also of considerable importance. All these points will have to be reckoned with in considering the electrification problem.

Reliable railway statistics perform two services. They show clearly to the management, and to those financially interested, the direct results of modern policies of long-distance fast trains. They also serve to show, when compiled with the accuracy and minuteness to be found in the Indian Government returns, the duties performed by, and cost of upkeep of, each typical unit of the rolling stock. They afford to the intelligent management the immediate localisation of any source of loss or point of poor economy. Hitherto, British railway returns, lacking in detail, have been of small value to the student of railway economics. The strong committee appointed by the Board of Trade should remedy all this. Electrical engineers would find complete returns of great value to them as affording possible grounds in estimating the cost of main line and goods haulage by electrical means.

Interest on Contractors' Capital.

ELECTRICAL and other contractors who have to lay out large sums on their undertakings are usually content to face the fact that capital so invested shall not bear interest. The "profit" made on the transaction includes the "interest" which is earned. But assume that, when the job is only half completed, the forfeiture clause is enforced, and the contractors are put off with the bare cost of so much work as they have done, have they no claim for interest upon capital tied up? This interesting point was discussed and decided in a recent case in the Privy Council. (Cape of Good Hope Government *v.* Hills, 22 *Times* Law Reports, 589). A firm of contractors undertook the construction of a railway for the Cape Government on payment of a subsidy of £2,000 per mile to be paid as the work went on. There was a clause in the contract to the effect that if the contractors failed to entirely complete the line, the Government might take possession of the completed portion, and thereafter as soon as the amount of the *actual cost* of the incomplete line should be ascertained by referees, pay to the contractor the amount so ascertained, less the amount of subsidies paid,

and certain retention moneys. The value of the incompleted line having been fixed by the referees, at £73,500, the contractors sued the Cape Government for this amount, claiming an additional sum for interest. It was held in the Privy Council (affirming the Cape Supreme Court) that the contractors had no claim for interest. In giving the opinion of the Court, Sir Arthur Wilson said, "To add interest seems to us to disregard the plain meaning of the word 'actual' as applied to cost. The referees have here as practical men found the cost of the works—in other words, they have said that so much money was expended in order to carry them out. To add something more in the name of interest would be to add something which never could be actual cost, for it would either be a sum calculated on an assumed general rate of interest, or it would be a sum which varied according to the financial position of the particular contractor."

Live Steam Feed Heating.

Mr. Davis, of the Halpin Thermal Storage, Ltd., writes to say that our comments on Mr. Wilkinson's paper on "Feed Heating," read before the Municipal Electrical Association, may give rise to misapprehension as to thermal storage, and wishes to state that the boilers at Wood Lane have not each a thermal storage vessel of 21,000 lb. capacity attached to them, but that each boiler has two vessels of 46,000 lb. joint capacity, which, when the boiler is steaming at 30,000 lb. per hour, will provide feed for one and half hours, or quite sufficient for the peak load. These particular boilers have 3,654 sq. ft. of heating surface, and, at 3·3 lb. per ft. per hour, are rated at 12,000 lb. We cannot agree, however, that it is an extraordinary performance to put up such boilers to do 30,000 lb., for their rated load is so low—only 3·3 lb. and, therefore, not to be compared with the output of Lancashire boilers. We do agree, however, that it is satisfactory to find a system that will enable water-tube boilers to perform better than the 3·3 lb.

As much as 36,000 lb. of steam per hour has, however, it is claimed, been obtained from the Wood Lane boilers, or at the rate of 8·5 lb. per sq. ft. of heating surface, and an efficiency over 24 hours of 72 per cent. has been obtained, and during the peak of 86 per cent., which last figure we beg leave to doubt. Our correspondent sends us some figures of tests which show evaporations per sq. ft. of heating surface of 8·55 lb. from a Babcock boiler of 3,240 sq. ft. with 52 lb. of coal per sq. ft. of grate per hour; 7·65 lb. evaporation from a Babcock boiler of 1,966 sq. ft.; 11·67 lb. from a Davey, Paxman boiler of 2,200 sq. ft. area, burning 41 lb. per sq. ft. of grate, and 11·25 lb. from a Niclausse boiler of 1,406 sq. ft. Our correspondent also states that he has obtained 14,400 lb. from a 30 ft. × 8 ft. 6 in. Lancashire boiler fitted with thermal storage. This, he says, is equal to 13 lb. of steam per square foot of heating surface. This, of course, is purely evaporation, the feed going in fully heated. It is also claimed for thermal storage that after a heavy peak load the large store of heat in the boilers is partially saved by being used to make steam to be sent into the storage vessels, and further, the storage vessels are excellent receptacles for the muddy deposit thrown down in them, whereby the boilers are kept clear of scale.

We realise all the foregoing, and do not think any remarks we have ever made are to be taken as inimical to the principle of thermal storage. Indeed, we have at times pointed out that the water-tube boiler had too little water in it. This lack is supplied by thermal storage better, perhaps, than if the stored hot water was in a Lancashire boiler, for the thermal storage vessel may be run dry without harm, not having any parts exposed to fire. But, after all, thermal storage is only a phase of the hot-feed question. It is not everyone that can find room for the storage vessels or for the expense, but most places can find room to heat the feed to boiler temperature before it enters the boiler. Mr. Wilkinson does this with a suitable spray heater.

Mr. Cruse adds a small drum to the steam drums of his water-tube boiler, and feeds the water into this over a sort of cottage roof exposed to the steam that is free to flow from the boiler, or he passes the feed through the central pipes of his superheater, and it enters the boiler as steam and water, and therefore fully heated. Mr. Booth says do not heat the feed water in the water space of a boiler, but heat it, if not already at boiler temperature, by live steam. In other words, keep the boiler to the single duty which its name implies—namely, to boil water by adding to it heat but not temperature. The duty of the boiler is to add latent heat, and it appears that when doing this and nothing else a boiler is doing more and better work than it will perform under any other conditions.

The Accident at Salisbury.

It is to be hoped that the lamentable accident to the American boat express will not be hastily assumed to be due to high speed, though, perhaps, it may turn out to be due to high speed round a curve which is ordered to be taken only at slow pace. If so, then it is due to mistake or over confidence of the driver who was killed, and it is to be feared took forbidden chances and trusted to getting round the curve without running off the line. A high speed train cannot easily leave the rails on a straight line; the first law of motion is against it, and this same first law says it shall leave the rail at a curve. Every curve is more or less an invitation to derailment. The necessary superelevation of a sharp curve for a speed of 60 or 75 miles per hour would be so great that slow-speed trains would fall off the inside rail. Superelevation must, therefore, be compromised, and this means that high speed cannot be run round such a curve with safety, for the only safeguard is then the flange of the wheel, and this is not much of a safeguard unless acting merely to second the laws of motion, and not to oppose them. It is, of course, open to be argued that on a line running fast trains, it is wise policy to flatten some of the curves, as the Midland Railway felt itself obliged to do in Derbyshire when speeds became higher, for one never knows when a driver may forget or grow indifferent and run too fast round a curve when he is, perhaps, bent on making a record run.

Rare Earth Auxiliary Conductors for Arc Lamps.—The excellent light efficiency attained in flame arc lamps, Nernst lamps and incandescent gas mantles is due to the presence in them of mixtures of the rare earth oxides, a characteristic property of most of which is the fact that they only become electrical conductors when heated. One of the earliest lamps in which the advantageous effect of such light-giving substances was noticed was the Jablochkoff candle (1876), in which the good light obtained was chiefly due to the presence of the rare earths in the substance used to separate the two carbons. The well-known Soleil lamp (1879) worked on a somewhat similar principle. These lamps have ceased to exist chiefly because of their short burning period, and the difficulty of starting the arc in them. An attempt to combine the advantages of these early lamps with those of the modern arc lamp points to the use of the rare earth mixture only as an auxiliary to the ordinary arc after the latter has been started. Thus a block of the material might be placed close to and above, but not in contact with the carbons of, a horizontal arc, so that when the arc had been started in the ordinary way, it would heat up the mixture and cause this to carry a certain amount of the current of the circuit, and so give out light in the same way as the filament of the Nernst lamp does. The advantages of such a combination are three-fold:—(1) Improved light efficiency; (2) good reflection of the light of the arc in a downward direction; and (3) improved steadiness of the light owing to the light-accumulating property of the rare earth mixture. The effect of this last action has been found to be very marked. The composition of the mixture is, of course, of the first importance, as, besides having the required electrical properties, it should be capable of withstanding the very high temperature with little or no vaporisation, so that frequent renewal is not necessary. Experiments have shown that one suitable substance is chamotte, which, though it becomes soft under the action of the arc, does not drop off. Further investigation in this direction may, however, lead to the discovery of some still more suitable substance.—E. Stadelmann, *Elektrotechnische Zeitschrift*.

ELECTRIC TRACTION PROGRESS ON THE LANCASHIRE AND YORKSHIRE RAILWAY.

On Friday evening last, on the invitation of Messrs. Dick, Kerr & Co., we, in company of several other technical journalists, travelled to Liverpool to join the foreign delegates, guests of the Institution of Electrical Engineers, next morning on a visit to the Lancashire and Yorkshire Railway Co.'s electrical lines.

Before meeting our welcome visitors, we visited the battery sub-station at Great Howard Street, and the Seaforth rotary sub-station, and on the arrival of the delegates at Seaforth, we all returned to Liverpool for luncheon in the Exchange Hotel. Brief speeches over, we entrained again for the Formby power house, which seemed to greatly impress our Continental and American friends.

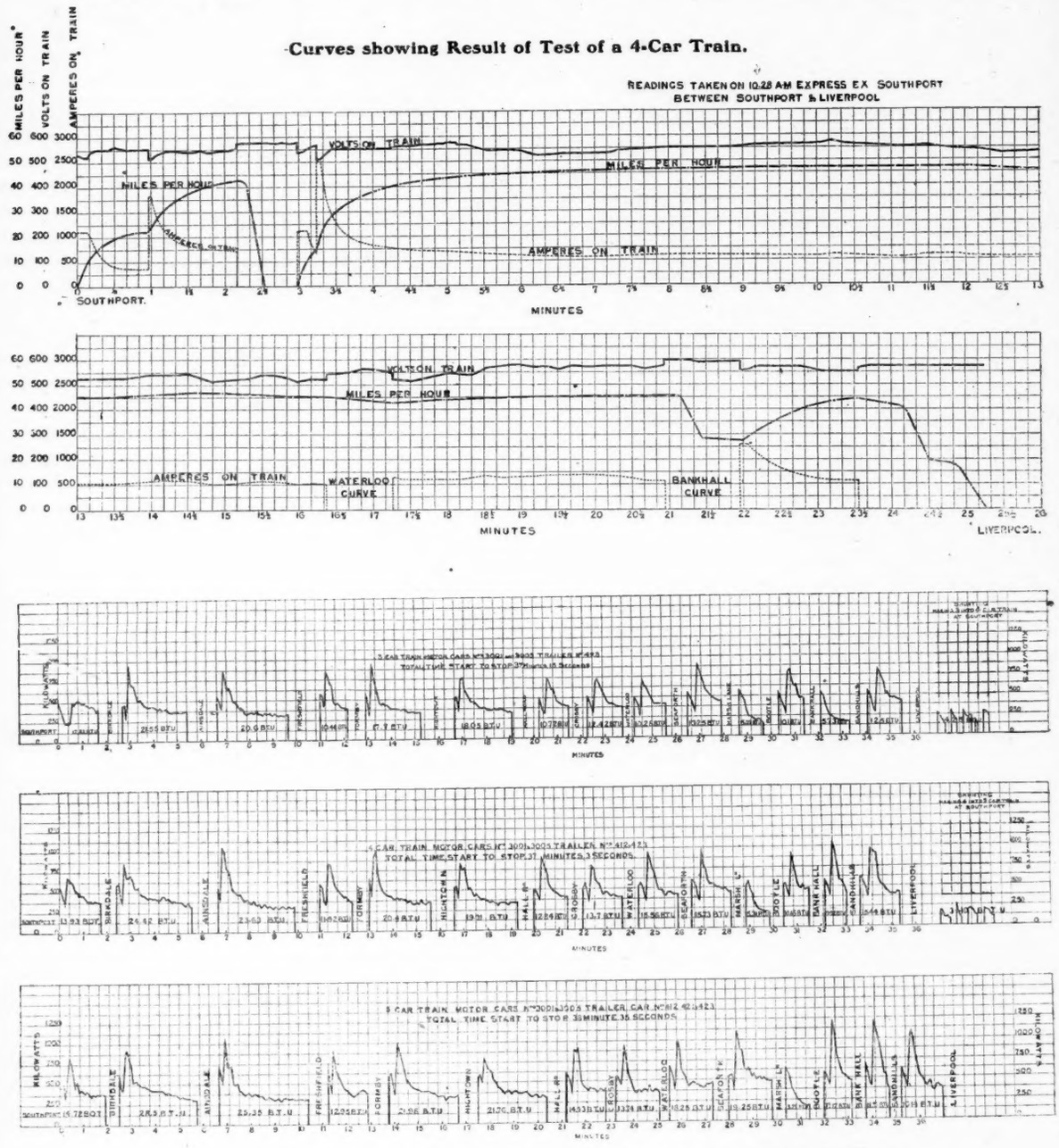
This visit to Liverpool of the members of the British and Foreign Institutions of Electrical Engineers brings prominently forward the progress which the Lancashire and Yorkshire Railway Co. are making in electrifying their several routes in the vicinity of that city.

The early summer of 1904 saw the inauguration of the electrical service over the first completed sections between Liverpool and Southport which embraced 47 miles of permanent way, a power and transmission plant of some 12,000 H.P., &c., and which at the time was described in detail in the Electrical Review.*

At the present time close on 60 miles of single track have been electrified, and this includes the extension from Southport to Crossens, on the road to Preston, as well as one of the branches which link up the Liverpool Overhead Railway with the original system at Seaforth.

The rapid growth of traffic has compelled the railway company to electrify all four roads between Bank Hall and Seaforth stations, two roads being reserved for fast traffic.

During the present year it is hoped to work electrically



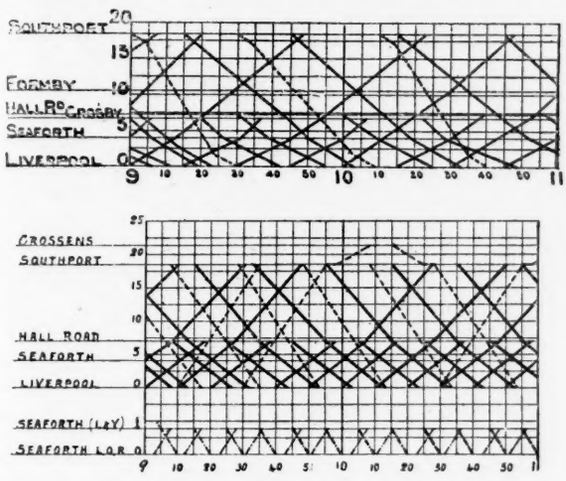
Curves Illustrating the Comparison of Energy on a 3, 4, and 5-Car Train.

Energy Consumption Curves of Electrical Trains on the Lancashire and Yorkshire Railway.

* Electrical Review, March 18th, 25th, April 1st and 15th, 1904.

further routes, viz., between Liverpool and Aintree, *viâ* Walton Junction, also the North Mersey branch, which will link Aintree up *viâ* Seaforth with the Southport line and the Liverpool Overhead route along the docks.

The completion of these extensions will result in a total of 75 miles of track being electrically worked. On June 1st a



Time Table Diagrams.—Upper, Steam Working, Oct., 1903; Lower, Electrical Working, Jan., 1906.

through service of about 28 trains daily were established over the Liverpool Overhead route and to Linacre Road station, situated on the North Mersey branch; a service to the Exchange station from that station has also been started.

It goes without saying that a greatly improved train service has resulted since the change over; the daily train-mileage has increased from 1,900 to 3,500, the Liverpool-Southport trains have risen from 36 to 70, and on the Liverpool-Hall Road section they have been increased from 36 to 60 daily.

The greatest improvement is visible in the running time, which between Liverpool and Southport has been reduced from 54 to 37 minutes, and from Liverpool to Hall Road, from 25 to 17 minutes.

The expresses run in each direction hourly, their time remaining unaltered, viz., 25 minutes.

Table Showing Comparison between Steam and Electric Services Lancashire and Yorkshire Railway.

Class of train.	From	Distance between terminal stations. Miles.	No. of stops.	Average distance between stations. Miles.	Steam. No. of trains daily.	Steam. Average frequency of service per hour.	Steam. Schedule speed per hour. Miles.	Electric. No. of trains daily.	Electric. Average frequency of service per hour.	Electric. Schedule speed per hour. Miles.
Stopping	Liverpool to Hall Road	7½	8	·89	38	4	17·0	57	6	25·0
,,	Hall Road to Liverpool	7½	8	·89	38	4	17·0	55	6	25·0
,,	Liverpool to Southport	18½	14	1·32	34	2	20·0	49	3	30·0
,,	Southport to Liverpool	18½	14	1·32	34	2	20·0	50	3	30·0
Express	Liverpool to Southport	18½	1 stop outside Southport.		4	3	44·5	15	1	44·5
,,	Southport to Liverpool	18½			4	3	44·5	16	1	44·5

Diagrams and tabular data of steam and of electrical working are giving above.

(*To be continued.*)

The New Liverpool Cotton Exchange Installation.—For the whole of the wiring for the electric lighting installation at the above exchange, as well as for the electric motors, the Northern Electrical and Ventilating Co., of Liverpool, are the contractors.

Mechanical Conveyors.—The South Metropolitan Gas Co. have placed a contract for a complete ammonium sulphate handling plant with the Chain-Belt Engineering Co., Derby. The latter company are also erecting a coal-handling plant for Grays Gas Co., and two refuse conveyors for the Southwark Borough Council.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Single-Phase Induction Motor.

In his last letter, Mr. Fynn has endeavoured to prove the identity of an induction motor with commutator and brushes short-circuited at 90 electrical degrees, with the ordinary induction-motor without commutator. Now, I think the method chosen for his demonstration, leads necessarily to results which can hardly be accepted. In fact, the fluxes M M_1 being, at synchronism, equal, and at 90° in space and time, produce a revolving field having the same speed as the armature which, in consequence, does not carry any current; then, how has the motor flux been produced? It is quite true, indeed, that at synchronism we have two equal fluxes at 90° in space and time, but it is equally true that in co-existence which such fluxes, that is, with the resulting revolving flux there are armature currents which are the determining factors of such revolving flux and not its effects.

It will be easy to arrive at the same result without the revolving flux conception. In fact, the flux cut at any instant by one of the windings, for instance, *c c* is: M sin at cos $v\,t$ − M cos at sin $v\,t$ = M sin $(a - v)t$, which is nil at synchronism.

In the vast literature on this subject, as far as I know, all the writers, all the theories and experimental results agree in giving the following interpretation to the phenomena concerning this class of machines. Considering a polyphase wound rotor, with open circuits, revolving at a speed v in a flux M alternating with a sinusoidal low, any of its circuits will cut a flux which is a complex function of the form: M sin at cos $v\,t$.

This flux gives rise to two sinusoidal E.M.F.'s, the frequencies of which, apart from constants, are $(a + v)$ and $(a - v)$. Each of these two E.M.F.'s produce a current of the same frequency when we close the circuits.

For the rotation of the armature, the current flowing in it, reacts on the primary member with the same frequency as the impressed one, and it can be seen that the E.M.F.'s component along motor and transformer axes are at 90° in time when the machine is running at synchronism, and they are both equal to the primary magnetising M.M.F. The M.M.F. along the motor axes remain undisturbed, but the other is incompatible with the existence of the primary winding. In fact it is in opposition with the M.M.F. necessary to drive the flux counterbalancing the primary impressed voltage, so the stator winding is obliged to redouble its M.M.F. in order to restore the flux necessary for the production of the back E.M.F. Apart from leakage, then, the no-load current is double the magnetising current. This theoretical result, I must add, is, according to my experience, in close agreement with the experimental observations.

In a much simpler way we could have arrived at the same conclusions with the help of the well-known theorem of Prof. Galileo Ferraris.

A propos of that, I must confess my inability to understand the reason for the contempt shown by Mr. Fynn and Mr. Atkinson for the rotating field theory.

The substitution of two revolving M.M.F.'s in place of an

E

alternating one is, by no means, a particular conception inherent to the electrical phenomena ; but it is applied to other branches of natural philosophy, being as legitimate as the decomposition of a force into its own components. There are no special restrictions for its application ; only in the special case of sinusoidal alternations, the speed of the two equal revolving M.M.F.'s is a constant one.

In answer now to the second question of power factor, &c., I will describe as follows the diagram which suggested to me the remarks of my last letter :—

I neglect the primary resistance and the other along the motor axes D D.

Let us call M_o in megawebers the flux cutting the primary conductors, and counterbalancing the applied voltage V. This flux, less (vectorially) the primary leakage flux, gives the flux M, which cuts the secondary conductors, and gives rise to the E.M.F., E T_c generated by transformer action :

$$E\,T_c = 1{\cdot}41 \left(\frac{N_o}{c}\right) \frac{\sim}{100} M \text{ at } 90^\circ \text{ with } M.$$

N_o = number of conductors in the rotor ; c = number of winding paths between brushes.

The same flux by motor action gives along

$$D\,D : \quad E\,B_D = 1{\cdot}41 \left(\frac{N_o}{c}\right) \frac{\sim_1}{100} M$$

in phase with M $\sim_1$ being the frequency of rotation. This last E.M.F. gives rise to the motor flux $M_1 = \frac{\sim_1}{\sim} M$, which, by cutting the armature conductors, produces the E.M.F., E B_c, in opposition of phase to E T_c. We have

$$E\,B_c = \frac{1{\cdot}41}{100} \left(\frac{N_o}{c}\right) \frac{\sim_1^2}{\sim} M.$$

We can consider this E.M.F. as generated by transformer action by a flux in opposition to M, and having the following value :—

$$M^1 = \frac{E\,B_c}{1{\cdot}41 \left(\frac{N_o}{c}\right) \frac{\sim}{100}} = M \left(\frac{\sim_1}{\sim}\right)^2.$$

In the diagram A F represents the impressed stator flux, and A E the portion of it cutting the secondary conductors, so that $\frac{A\,F}{A\,E} = \nu_1$ is the primary leakage coefficient.

The segment B F = E C is the flux produced by the armature and cutting the primary conductors, so that the segment A B represents the flux M_o, which is constant if the applied voltage is constant. The flux M is represented by the segment A C. For a certain speed let us represent by C C′ the flux M′, the difference A C′ is, then, the flux which by its component A D′, produces the E.M.F. necessary to drive the current against the armature resistance, and by the other component D′ C′ counterbalances the secondary leakage flux given by C E $(\nu - 1)$, in the supposition that the secondary leakage coefficient is the same as the primary one.

The segments A D, D B′ being at 90°, the point D moves on a circle, the diameter of which is A B′ = $\frac{A\,B}{\nu}$.

The angle A C′ D′ = A C D = d is a constant one, and it is given by

$$(1) \qquad \tan d = \frac{3{\cdot}14 \times r_o \times p \times R\,10^8}{\left(\frac{1{\cdot}41\,N_o}{c}\right)^2 \sim (\nu - 1)}$$

where r_o = armature resistance, p number of poles, R = reluctance of half magnetic circuit.

As a consequence of that, the point C moves on a circle subtending the angle $180^\circ - d$ and passing by A and B′.

It will be easy to see that, if B L = $\frac{A\,B}{\nu - 1}$, the point F moves on the circle, passing by B and L and subtending the angle $180 - d$, and that

$$(2) \qquad \frac{B'\,C}{C\,D} = \frac{B\,F}{F\,F'} = \frac{1}{\nu}\left[1 - \left(\frac{\sim_1}{\sim}\right)^2\right]$$

when $\sim_1 = 0$, B $F_o = \frac{F_o\,F'_o}{\nu}$, so that, by varying the resistance r_o, the point F_o moves on a circle, the diameter of which ($r_o = 0$) is

$$B\,L' = \frac{L'\,L}{\nu} = \frac{B\,L - B\,L'}{\nu},$$

hence $B\,L' = \frac{B\,L}{\nu + 1} = \frac{A\,B}{\sigma}$ where $\sigma = \nu^2 - 1$

is the well known leakage factor of the transformer.

We see then that, at stand still, the diagram changes its physiognomy, and we recognise at once our old acquaintance, the circle diagram for a transformer.

For a certain value of $\sim_1$ we can find, by the use of (2) the primary current A F, the secondary current B F, the power factor cos φ, &c.

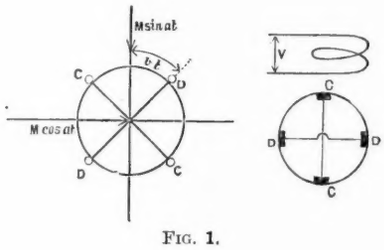


Fig. 1.

We can introduce, in the ordinary way, the representation of iron and friction losses ; in that case the no-load current will be represented by $A_1 F_1$, the open rotor current by $A_1 B$ (if we suppose the iron losses to be constant), the power factor by cos V A_1 F, &c.

The torque is proportional to

$$F\,P \frac{\sim_1}{\sim} \text{ or to } F\,P \sqrt{1 - \nu \frac{B\,F}{F\,F'}},$$

from which expression we can derive the maximum torque of the motor, or the minimum speed at which the machine can run. In conclusion, the method for tracing the diagram can be resumed as follows :—Take any segment A B which will fix the scale of currents in the primary, and the scale of all the other elements. Find the leakage factor σ of the transformer, and take

$$B\,L^1 = \frac{A\,B}{\sigma}, \text{ and } B\,L = \frac{A\,B}{\nu - 1} = \frac{A\,B}{\sqrt{\sigma + 1} - 1}.$$

By knowing the secondary resistance of the transformer, the point F_o can be located on the circle B L^1.

The circle determined by the points B, F_o, L, is the locus which gives the primary and secondary currents, the torque, &c., for any given load.

We see from the diagram that cos ϕ increases with the load, and becomes a maximum at standstill, as I stated in my last letter.

The correct diagram which takes into consideration the resistance along the axes D D is of course more complicated,

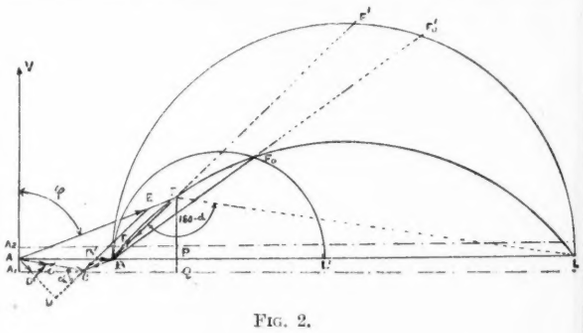


Fig. 2.

and shows that, in an ordinary machine, the influence of that resistance is of little importance, specially with regard to the power factor.

Of course the above diagram shows a lower power factor than the true one, because the primary resistance has been neglected. This last item could be taken into considera-

tion* if we would sacrifice the beautiful simplicity to an unnecessary exactitude.

N. Pensabene-Perez.

Witton, *June 6th*, 1906.

Electrolysis and Joint Boxes.

In last week's issue of the Electrical Review, "The Writer of the Article," in his reply to his critics, is more erratic and evasive than ever. The manner in which he slides around the pertinent questions of "Mains Engineer" is extremely weak. With regard to myself, "The Writer" is as shifty as ever. He opens the ball by making a false charge, then he falls back upon the text-books, followed up by the usual mis-statements, and winds up by jumping at a wrong conclusion. I feel that it is due to you, Sir, and your readers, that the odious suggestion, "he must hold a brief for joint-box makers," should be contradicted at this stage, as it is as groundless as repulsive, especially as I have never had any connection with any firm of joint-box manufacturers.

With regard to the text-books, with all due respect to the writers quoted, I do not consider this by any means evidence against my statement, as at the time that these books were written, a composite duct with an insulated lining, was already in use across the "pond" to protect both cables and joints. This duct was very effective, but, of course, costly.

"The Writer" alludes to "lead sleeve tee joints." I don't remember seeing these in the text-books either, and really think that they must be a thing of the past, as a lead box tee joint is the present practice.

We now come to a bold announcement, "Such bushes were condemned as insulators,"—by whom, the text-books? In practice they were never intended as such, but were introduced as a bush to protect the cable from abrasion, and to prevent the iron-box crushing the lead, when screwed down. Take, for instance, the iron joint box used on armoured triple-concentric cables; the practice has always been to clamp the armour of the cable under the outside slide, and then the bush has been put over the lead, after the armour has been cut back, and clamped down by the inner slide, thus continuing the mechanical protection of the armour inside the pocket of the box. Now, it must be obvious to all, that if the wood bush had been intended to insulate the cable from the joint-box, a splendid earth would not have been made by clamping the armour of the cable tightly in the ends of the box, thus defeating the object aimed at. I am afraid "The Writer" must try again! With regard to boxes made with insulating material, the idea is by no means new. I had such a box in use many years ago, and although the design was very good and the workmanship of the best, its life was very limited, although it was tried under favourable conditions. All of them developed the same defects within a short time of each other, which was entirely due to moisture creeping in through a bush which was screwed into the box. If space and time permitted I could give you a score of different kinds of bushes and glands that have been tried and found wanting when put to the great test—time, underground.

"The Writer of the Article" concludes that I must be "a disciple of Mrs. Eddy." Wrong again! My forte is prevention not "cures." I would advocate vivisection—on live cables—or, if necessary, amputation, rather than live in a fool's paradise even if it were made of glass.

It will be a great pity if this correspondence is allowed to fizzle out through "side tracking" and "blowing off," as if kept to the main track much light can be thrown on the points at issue by "Mains Engineer" and others similarly situated, especially those with Colonial and American experience. The latter, I am sure, could furnish much interesting information, as they have to battle with similar difficulties to ours, often-times aggravated by the varying conditions of extreme hot and cold climates, certainly the worst conditions for cable work.

Sero sed Serio.

July 2nd, 1906.

* See a similar case treated by the author in the *Bulletin* de l'Association des ingenieurs sortis de l'Institut Electrotechnique Montefiore de Liége, Nos. 6-7-8 (1904).

Separation of Oil from Feed Water.

The writer of the original article on this subject is wrong in his theory of the exhaust steam separator: there is no "sudden expansion of the steam into the separator, which causes reduction in the surface tension" (whatever that may mean), "and thus renders the steam incapable of holding the oil." This is a common error, which makers of this type of apparatus, who ought to know better, have helped to propagate.

Exhaust steam separators are simply devices to facilitate the precipitation, inertia separation and adhesion of the oily particles. There is expansion of the current or reduction in current density, but no expansion of the steam or reduction in volume density.

I read a paper before the Junior Institution of Engineers in April, 1903, which gives the reason for the increased difficulty of separation in high vacuum. The volume of 1 lb. of saturated steam at atmospheric pressure is approximately 27 cb. ft., while at 4 and 1 lb. absolute pressure its volume is 89 and 330 cb. ft. respectively; consequently the velocity of flow increases enormously with decrease in pressure.

An exhaust separator does useful work when fitted to engines requiring liberal lubrication and using saturated steam, but serves no useful purpose when superheated steam and little lubricant are used, as the oil is vaporised, and no mechanical device can discriminate between the vapour of oil and the vapour of water. Facts are stubborn things, and much disappointment and expense might be avoided were they fully appreciated.

Absolute removal of all trace of oil is imperative when high-pressure and temperature steam is used, and can only be obtained by chemical treatment for coagulating the oily particles. After coagulation, the oil is readily removed by straining through wood fibre; but you cannot rely upon securing a uniformly clear effluent unless the wood fibre strainers are cleaned out frequently, as the separated impurities are simply held in mechanical entanglement, and must come through sooner or later.

To prevent the possibility of these impurities passing to the feed-pump suction, we fit a quartz sand filter for the final purification, and so, eliminating the human element, are able to give most binding guarantees. The plant at Messrs. Harland & Wolff's electric generating station was supplied on six months' trial. At the end of that time our clients had the option of purchasing the plant, or returning it to us, if there was the slightest trace of oil found in the boilers; no payment being made until acceptance. At the end of this six months' trial they reported "the boilers opened out quite clean and free from oil." It should be noted that there are no exhaust steam grease separators in this installation, nor economisers between the feed pump and the boilers.

William Paterson,
Managing Director,
The Paterson Engineering Co., Ltd.

London, W.C., *June 27th*, 1906.

Tramcar Brakes.

I think everyone who has studied the difficult question of brakes on mechanically propelled tramway cars will admit that the "mechanical track or slipper brake" is certainly far more reliable than any form of electric brake. With the usual ordinary inspection, the chances of a mechanical contrivance such as the "mechanical slipper brake" getting out of order are very remote indeed, but with the electrical slipper brake there are so many points which are liable to break down, and they are very difficult to detect, however efficient the inspection may be. The electrical brake is solely dependent on the revolution of the wheels for its operation, and in the majority of accidents it is found that the driver of the car momentarily loses his reason, and instinctively applies the brake which he is constantly in the habit of using for service stops (the hand brake) as hard as possible, thus immediately locking the wheels and making the principal element (the motors) of the electric brake inoperative.

The mechanical brake or slipper brake is perfectly indepen-

dent of any other brake or device on the car, and the harder you apply it, the greater is the retardation of the car, or, in other words, the quicker the car is stopped.

The electrical brake certainly has a greater rate of retardation than any other braking device at present on the market, but this depends solely on the wheels of the car revolving (while in the majority of accidents it is found they are locked—this is due to the errors of judgment of the driver, but it is an important fact, and must always be taken into account).

If the cars on which all the recent very serious accidents have occurred had been equipped with the mechanical track or slipper brakes, the chances of an accident occurring would have been very remote indeed. Up to the present there has not been a case of a single car fitted with mechanical track brakes running away down hill.

It is well known amongst all electrical engineers that electrical contrivances are not to be relied upon, and for safety devices mechanical contrivances are to be preferred.

I think it will be admitted by all prudent and experienced tramway engineers and managers that for all safety devices mechanical apparatus is far more reliable than any electrical apparatus.

Trusting that this letter may be of interest to some of your readers, and that it will help in some small way to prevent any further bad accidents by raising the whole question of brakes.

Tramway Engineer.

(18½ years' experience.)

London, *June 28th*, 1906.

[It is hardly necessary to say that we are not responsible for the statements made by our correspondents. We shall have occasion to discuss the tramcar brake question shortly. —Eds. E.R.]

Steam Turbines.

I read the paper of Mr. Sydney W. Baynes, chief engineer of St. Pancras, with the greatest interest, and noted particularly the remarks this gentleman makes as regards the Rateau turbine.

According to this paper the Rateau Co., and also makers of the "Zoelly" turbine, are still building their turbines in two sections, the revolving parts being carried by three bearings. Mr. Baynes, though, states that the makers contemplate to build in future turbines in one section.

This, of course, is no novelty at all. The Oerlikon turbine, which was originally built upon Rateau principles, has long been built monocylindrical, and the economy of these turbines above the machines built in two sections has been a special feature for some considerable time past. This, and the common advantage to all impulse turbines of practical independence as regards "clearance," makes the Oerlikon turbine one of the most compact and economical machines, and the many sets which have been running successfully for a long time, and the large number of units, from 200 KW. to 4,000 KW., now going through our shops, are sufficient proof of the appreciation customers show for the excellent design and execution of the Oerlikon pure impulse turbine.

G. Wüthrich.

(Maschinenfabrik Oerlikon.)

London, W.C., *July 2nd*, 1906.

Inaccurate Electricity Meters.

In reply to "Only One Case," I have had exactly the same thing happen myself. I tested the old meter, and found it an average of 5 per cent. slow. The readings had been uniform for the last two years. The next quarter's bill went in, and the usual trouble followed. I went up and saw the party, who, by the way, was an old lady of about 80 years of age. I stated the facts regarding the old meter, then she began to argue as to how I knew that the new meter was right, and why not put the old meter back again, as she was quite satisfied. Well, after sundry reports of tests, I got her very nearly convinced that the new meter was right, and finally informed her that by right I ought to charge her 5 per cent. on the last six quarters' bills, but that I was doing her a great favour by only charging her for the last full quarter. So she thought it advisable to pay and say nothing more about the matter. The next quarter being Midsummer, the bill was nothing compared with that of the last, so I have not heard anything more of the lady since.

Meter Superintendent.

Street Lighting.

In spite of the appearance of two letters from independent sources, conveying identically the same hints, "Dulciter Dormans" still does not seem to recognise that the two garbled statements put forward by him are not "laws" in any sense of the word.

Of the two extracts attributed to Mr. A. P. Trotter, the first points to the question of diffusion, "a dead white surface" being of the essence of the statement, while, if the second means anything at all, it means that the source of light should be as near and as mediately situated with regard to the reflector as possible. From this it is very evident that "Dulciter Dormans" does not understand the proposition himself (although he is egregious enough to attempt to teach others), or he would not make the statement that the solid angle subtended by Mr. Tracey's reflector is "very small," when, on the contrary, it could hardly be made much bigger. His knowledge of mathematics is evidently on a par with his knowledge of physics and Latin. With regard to my lack of good manners, everyone knows that candour and politeness cannot always go together. As for my lack of intelligence, I should like to convey the surprising news to "Dulciter Dormans" that most of us know as much about the subject as he does.

Ubique.

Wireless Telegraphy.

In my note on wireless telegraphy which appeared in your issue of May 11th, 1906, the fine decimal divisions did not reproduce in fig. 1, and the intensities consequently appeared as only one-tenth of their proper value. The intensities in fig. 1, as published, should be multiplied by ten, so as to make the intensity on January 10th 240 times audibility.

In the top right hand paragraph, page 745, the date January 30th should be changed to January 10th. On January 30th I find from the operators' notes the signals were audible with the 'phones six inches from the ears. This correction is made for the purpose of allowing a comparison with the scale of intensities used.

Reginald A. Fessenden.

Brant Rock, Mass., *June 20th*, 1906.

L.C.C. Electric Supply Bill.

In your report of my evidence, it is stated that I put down the fuel consumption per B.T.U. at the proposed works of the L.C.C. at 5 lb.; that is an error. I took the figure given by the L.C.C. engineer, which was 3 lb., and calculated the tonnage of coal required upon that basis.

Arnold Lupton.

House of Commons, *July 1st*, 1906.

Efficiencies of Direct Current and Alterrate Current Motors.

In your issue of yesterday an unfortunate misprint has occurred in the most vital figure of my table of efficiencies of different motors; the full load efficiency of 5 B.H.P. direct current motor should be 85·2 per cent., instead of the obviously wrong figure of 36 per cent. stated. The correct figure agrees very well with those given by Mr. Ellis for D.C. motors of similar output, from the maker's figures.

Charles V. Drysdale.

Northampton Institute, E.C.
June 30th, 1906.

[This unpardonable error, which we deeply regret, was entirely due to the printer, having occurred in making proof corrections.—Eds. E.R.]

Copper Jointing Sleeves.—A correspondent writes :—"There is a patented joint for overhead wires on the market consisting of a copper sleeve about 9 in. long made of soft copper, into which the two ends of the wires to be jointed are inserted and the whole twisted about three times to complete the joint. We should be very much obliged if you would, through your 'Correspondence' column, ascertain for us the address of the firm which supplies these tubes."

[Held Over.—We regret that we are compelled to hold over until next week a letter from the Campbell Gas Engine Co., Ltd., regarding "The R.A.S.E. Suction Gas Plant Trials."—Eds. E.R.]

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Visit of Kindred Institutions.

On Thursday morning last week, at 8.15, the visiting electrical engineers, accompanied by their ladies, and by a somewhat small proportion of members of the I.E.E.—some 40 in number—embarked upon the circular tour which had been organised, and which included visits to Rugby, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Newcastle and Leeds, besides a trip through the Lakes and an excursion on the Clyde. This heavy programme was to be executed within a period of 10 days, and some apprehension had been expressed by the *Daily Mail* as to the physical condition in which the "survivors" of the party would reach its conclusion—if, indeed, they endured so far. Our friends of the lay Press, however, little know the stuff that electrical engineers are made of; for them such a tour has no terrors. After their historic progress through the United States in 1904—a veritable *tour de force*—the present expedition could be regarded, in the language of our "Business Notes," as a mere "outing."

A prefatory word of praise is merited by the admirable arrangements made to secure the comfort of the travellers. The special train provided by the London and North-Western Railway Co., and used by the party throughout the entire round, comprised nine first-class dining coaches and two luggage vans, the corridors being continuous from end to end. An adequate staff of cooks and waiters accompanied the train, though only occasionally was it necessary to partake of meals on board, and the fittings and furniture were worthy of the company and the occasion. Even Americans, who are accustomed to a high standard of comfort in railway travel, expressed their appreciation of the convenience and comfort of this smoothly running train. Further, the heartiest congratulations are due to the committee and staff of the Institution in whose hands rested the organisation and management of the tour, and to the committees of Local Sections of the Institution which carried through the arrangements at their respective centres. Mr. R. Kaye Gray was the chairman of the central committee, and to mention this fact is to say that nothing that forethought and consideration could do to ensure the perfection of the arrangements was omitted. Special thanks were also due to Prof. J. D. Cormack, who, as hon. sec. of the Ladies' Reception Committee, bore the brunt of the work, and accomplished it in a manner which not only left no room for criticism, but called for the highest commendation.

Mr. G. C. Lloyd, the secretary, was indefatigable in his efforts to promote the comfort and enjoyment of the whole party; Mr. P. F. Rowell, assistant secretary, and Mr. R. Tree were equally assiduous, and were cheerfully assisted when necessary by volunteers. The arrangement of the tour was not only admirably organised, but was in general punctually carried out, and repeated expressions of approval and praise reached our ears.

Sad to relate, at the commencement of the tour there occurred a short spell of dismal weather; the sunny warmth of the three days in London was replaced by cold and rain. Those who detrained at Rugby, to inspect the works of the British Thomson-Houston Co. and Messrs. Willans and Robinson, were not seriously inconvenienced, but the ladies' visit to Stratford-on-Avon was most regrettably marred by continuous rain. Most of the party proceeded direct to Birmingham, where they divided into three groups to visit (*a*) the works of Messrs. Belliss & Morcom, Ltd.; (*b*) the Summer Lane electricity works of the Birmingham Corporation, and the works of Messrs. Elkington & Co.; (*c*) the works of the Metropolitan Amalgamated Carriage and Wagon Co., Ltd., Saltley, and of the Wolseley Tool and Motor Co., Adderley Park.

The visitors were conducted over the Birmingham Electricity works by the city electrical engineer, Mr. R. A. Chattock, and his assistants. These works contain direct current generators for lighting and traction, built by Messrs. Dick, Kerr & Co., Ltd., and driven by Belliss triple-expansion engines, of 4,500-kw. output; turbo-dynamos by Messrs. C. A. Parsons & Co. of 1,000-kw. output; and three-phase alternators by the British Westinghouse Co. of 4,500-kw. output, driven by Belliss & Morcom engines. The coal-handling gear was of special interest, and included, we were informed, the longest bucket-chain conveyors in this country, each chain consisting of 480 buckets. We were pleased to note that Mr. Chattock had modified the construction of the furnaces of the Babcock & Wilcox boilers so as to increase the combustion space over the grate, with a view to securing that perfect combustion which we have so long advocated. Coal is received by canal, carried by a belt conveyor to a weighing machine, and finally deposited in bunkers of 2,000 tons capacity over the boiler house by the bucket-chain conveyors, installed by the New Conveyor Co.

Amongst other features of the installation the massive d.c. switchgear, which contained, we should think, some tons of copper, attracted much attention; the permanent arrangements for carrying out complete tests on the steam consumption and efficiency of any generating set also are exceptionally complete.

At Messrs. Willans & Robinson's works the visitors were met by Mr. Robinson and Mr. Peache, who, after a cordial welcome in the office building, led them round the factory.

The greatest interest was taken in the turbine department, where a large amount of work was in progress. Some parts of the turbines for the new Cunard liner were shown, the blades for the lowest pressure stage of which were 2 ft. long by 2 in. wide.

Other turbine work of interest was shown, including six 3,000-kw. sets for operation at 750 r.p.m 180 lb. steam pressure and 100° F. superheat. Three of these were for the Glasgow Corporation, two for the St. Andrew's Cross station in Leeds and one for the Lancashire and Yorkshire Railway.

The following constructional points were pointed out as the latest practice of this well-known company in their turbine work :—

Definite ventilation of the turbo-generators; the inlet and outlet of air are controlled and can easily be arranged for forced ventilation if this is made necessary by special conditions of operation.

Lubrication of bearings is maintained by oil under pressure supplied to the centre point and carried along the surface by one longitudinal groove.

The by-pass is arranged for automatic operation from the governor when the throttle is fully opened.

The high pressure end of the casing is mounted on a machined surface, which allows sufficient motion to provide for the expansion due to change in temperature.

The pipes carrying steam to the balancing pistons now run separately outside the casing to the balance rings, and are provided with an expansion joint.

At one o'clock the parties from Rugby arrived at Birmingham, and all proceeded to the Grand Hotel, where they were entertained to luncheon by the General and Local Reception Committees and the members of the I.E.E. Sir Oliver Lodge presided, and after the loyal toasts, welcomed the visitors in the name of the Local Section, the city of Birmingham, and the University. He referred to the hard work of preparation done by Mr. Vaudrey, Prof. Kapp and Dr. Morris, and remarked on the incursion of electricity into every department of modern life. Prof. Kapp, recalling his visits to Italy and Switzerland with the I.E.E., was pro-

ceeding to refer to the Berlin visit, when he recollected that on that occasion he was with our hosts, and appeared undecided as to the capacity, host or guest, in which to speak! He hoped they would derive no less benefit from the present visit than we had from the former, and explained the difficulty of selecting the few works on the programme from amongst the many good things there were to see in Birmingham.

Mr. Wheeler, President of the American I.E.E., declared that the hospitality and goodwill of the British had immensely impressed the foreign engineers, and he proferred on their behalf the most sincere thanks.

Signor G. Semenza, on behalf of the Italian Electrotechnical Association, heartily joined in Mr. Wheeler's remarks. One often admired copies of great works of art, he said, and when some day one saw the originals it seemed like meeting old friends. Thus, after admiring Sir Oliver Lodge and Prof. Kapp from afar, he now had the pleasure of meeting them in person, and he proposed their healths in conjunction with that of the Organisation Committee.

Mr. Gavey, President I.E.E., expressed the thanks of the party for the Lord Mayor's invitation to the Council House, and Sir H. Rogers, acknowledging the courtesy on behalf of the Lord Mayor, said he hoped the visitors would not be allowed to see the old steam tramcars.

Business was then resumed. Three parties were formed, of which one proceeded to the new buildings of the Birmingham University, one to the works of the General Electric Co. at Witton, and one to the works of the Birmingham Small Arms Co. at Sparkbrook. The slight rain of the morning had given place to a steady downpour, and as the local organisers, with a cheery optimism that would have been more cordially appreciated had it been justified by the result, had provided some of the conveyances *without* covers, not a few members of the party got wet through. The cheerful spirits of our visitors, however, were undamped, however moist their garments, and, so far as we know, no one suffered any after ill-effects from the mishap.

The electro-technical features of the University and the G.E. Co.'s works have been described in our pages. Of the Birmingham Small Arms Works we can only say that their excellent organisation and equipment were no less admired than the beautiful work done in their many departments, and that it was difficult to say whether a cycle "made like a gun," or a rifle "made like a cycle" was the more highly honoured by the description. An hour in these shops only whets the appetite for a day there; but the programme must be fulfilled, and at half-past five all parties, now including also the ladies, met at the Council House, and were received by the Lord Mayor. Tea and refreshments were partaken of, and the collection of beautiful pictures and other *objets d'art* in the adjoining art galleries was appreciatively inspected. At 7.45 the party left for Manchester, dining in the train, and arrived there in good order at 9.45 p.m. The programme for the day, however, contained no further items, and we believe most of the travellers retired to rest.

On Friday, June 29th, the first item on the programme was a reception by the Lord Mayor of Manchester, and the Mayor of Salford, at the Town Hall. This function was carried out with full civic ceremonial, and took the form of a cordial welcome to the visitors, to which Mr. Gavey appropriately responded.

The party then proceeded to Stuart Street electricity works by special cars, under the guidance of the city electrical engineer, Mr. S. L. Pearce, and his assistants. Meanwhile, the ladies were conducted round the Town Hall and the City Art Gallery by the Lady Mayoress and other lady residents. Needless to say, the magnificent power station erected by the Corporation at Stuart Street—the largest of its kind in the kingdom—greatly interested the visitors. One of the fine Wallsend Slipway engines was running on load, and the other generator was run up and paralleled with it for the edification of the party. The coal-handling plant here appeared colossal, partly because it included a private railway carried on a brick viaduct, an unusual feature of a power station. Both Prof. Kennedy's station, and the extension designed by Mr. Metzger, are now complete; as they have been fully described in the Electrical Review, we need only mention that the total capacity of the plant is 16,500 kw., and adding the joint output of Dickinson Street and Bloom Street, the aggregate capacity of the three works is no less than 32,800 kw. When, on the completion of the first Stuart Street station, fears were expressed that the extension of 7,500 kw. then in progress was excessive, we stated our belief that no long time would elapse before the full capacity of the works was usefully employed, and we are pleased to find our prophecy rapidly approaching fulfilment. There are over half a million lamps connected (8-c.p. equivalent), and motors of over 12,000 h.p., while the tramways account for 12,500 h.p., making a total of nearly 40,000 kw. connected. The maximum load last year was 20,855 kw., and the power load, thanks to the adoption of a forward policy of low prices, on the recommendation of Mr. Pearce, is increasing by great strides.

The Dickinson Street works were also open for inspection, and were visited by a few members of the party. This plant was of great interest, since it contained machines of various periods down to the three new La Cour converters and the two new Parsons-Siemens turbo-generators.

The La Cour converters are arranged for operation on either the 400-volt or the 550-volt direct-current bus-bars, with outputs of 1,200 amperes and 900 amperes respectively. The normal speed of the sets is 428 r.p.m., and the alternating current end is wound for 6,500 volts, three-phase, 50 cycles per second.

All three of these converters were operating at the time of the visit at an overload of about 10 per cent. with black commutators and very slight heating. The engineer in charge of this station stated that exceedingly heavy overloads did not pull these machines out of step, and expressed great satisfaction with their operation.

It was interesting to note that more than 20 different hands had synchronised these machines with ease during the few months of their operation, many of them being inexperienced men. These machines can be synchronised in about 1 minute 40 seconds average, which, therefore, compares favourably with a rotary converter.

Two field windings are provided, and on lighting loads (400 volts) the machine operates shunt wound, while on traction loads (550 volts) a series field is connected in.

The starting is done from the alternating-current end by means of resistance inserted into the rotor winding, which is brought out through slip rings.

We are able to state that 10 similar converter sets are now on order. All the switchboard apparatus was supplied by the British Westinghouse Co., and the converters by the Bruce Peebles Co., of Edinburgh.

At 12.45 p.m. the various parties reassembled at the Town Hall, where they were entertained to luncheon by the Lord Mayor of Manchester, the Mayor of Salford, and the Electricity Committees of Manchester and Salford, in the Council Chamber, of which the walls and ceiling are ornamented with beautiful frescoes and the coats of arms of the nations. Proposing the first toast, the Lord Mayor pointed out that that day was observed as the King's birthday, and the first verse of the National Anthem was sung with enthusiasm. Proposing "Our Visitors," the Lord Mayor said he was glad to see them on this unique occasion in Manchester, where the largest municipal electrical undertaking and the largest manufacturing electrical works were found. Mr. Wheeler, President of the American I.E.E., referred to the special interest of the Manchester works in view of the investigation into municipal undertakings now in progress.

Mr. Gavey, on behalf of the ladies, was deputed to express their deep appreciation of the kindness and courtesy of the Lady Mayoress, whose health was honoured with enthusiasm, and whose brief, but admirably worded acknowledgment, was certainly the speech of the day. Councillor Hawarth, chairman of the Electricity Committee, proposed the healths of the Lord Mayor and the Mayor of Salford, who briefly responded, and the party returned from refreshment to labour, the engineers proceeding to the works of the British Westinghouse Co., Ltd., at Trafford Park, while the ladies were taken on a motor-car excursion to Buxton.

At the Westinghouse Works great interest was shown in the steam turbines, several of which were in course of construction; the process of blading attracted much attention,

and the compensated D.C. generators were examined with keen interest.

The single-phase railway, operated at 3,000 volts, was also a noteworthy feature, and the visitors were taken over the track in a standard railway car. It would be idle to attempt to refer in any detail to the interesting tools, many of which are of enormous size, with which these huge works are equipped, or to the numerous types and species of machines manufactured there; we may mention, however, an ingenious system which has been adopted for driving the large planers, in which belts running always in the same directions are alternately tightened by jockey pulleys, thus reversing the motion of the bed, and securing quick return while the motor runs continuously at constant speed. Steam turbines, gas engines, dynamos, alternators, motors, controllers (on a new plan), meters, &c., were being manufactured, and even steel castings for ships' anchors were included in the scope of the factory, to inspect which adequately would require a week rather than an afternoon.

Refreshments on a generous scale were provided by the company. Afterwards the visitors embarked on a steam tug, and were taken to various docks in connection with the Ship Canal: but, what with the chilly air and what with the aromatic (?) odours, we fear this part of the day's work was not duly appreciated, and the inspection of the electrical equipment at one of the docks, which was on the programme, was omitted. The party returned to their hotels in the special cars, which merit a word of commendation on the score of their comfortable arrangement and neat top-covers. The organisation of the whole of the day's doings was admirable and well devised.

In the evening the Vice-Chancellor of the University, Dr. Alfred Hopkinson, and the Council held a reception and conversazione at the Victoria University. The laboratories were open, and many very interesting demonstrations were given by the staff and students.

On Saturday morning the visitors proceeded to Liverpool, where they were received, at Lime Street Station, by the Lord Mayor and Lady Mayoress, with Sir Charles Petrie (chairman) and other members of the Tramways and Electric Power and Lighting Committee. Outside the station decorated cars, one of which carried a band, were in waiting to convey the party to the Lister Drive power stations, and the cordiality of the city's welcome was amply demonstrated.

The two stations at Lister Drive formed admirable examples of the remarkable change in power station practice which has taken place in recent years, one being filled with twelve Willans-Siemens steam dynamos of 9,000 KW. capacity, while the adjoining station contains four Westinghouse turbo-alternators of 7,200 KW. total capacity, generating at 6,000 volts, three-phase, with space for as many more, though both stations are about equal in size. The stations are conveniently arranged, with boilers along either side, and the switchboards at one end. Lancashire boilers are installed in the older station, Babcock & Wilcox boilers in the new one. It is noteworthy that storage batteries are installed in the D.C. station. Mr. A. B. Holmes is the consulting electrical engineer, and Mr. Arthur Clough resident electrical engineer.

Leaving Lister Drive by tramcar, the party was conveyed through Liverpool to the Dingle station of the Liverpool Overhead Electric Railway, and proceeded in a special train to Seaforth station on the Lancashire and Yorkshire Railway, where the visitors boarded a special L. & Y. train, and were taken to the Exchange station. There they were entertained to luncheon by the Tramways and Electric Power and Lighting Committee of the Corporation, at the Exchange Station Hotel. After the loyal toasts, Alderman Sir Charles Petrie proposed "Our Visitors," to whom he offered a hearty welcome. Dwelling on the enormous progress made by electrical engineering, the chairman said that, thanks to our national caution, no great mistakes had been made in Liverpool. On behalf of the Committee, he thanked Mr. J. A. F. Aspinall, general manager of the L. & Y. Railway, and Mr. S. B. Cottrell, engineer and manager of the Overhead Railway, for placing their trains at the disposal of the visitors. Dr. Epstein responded in an eloquent speech, and was followed by one of the French engineers. Mr. Gavey proposed the health of the Lord Mayor, who briefly replied, and Dr. R. T. Glazebrook that of Sir Charles Petrie, which was suitably acknowledged.

The visitors then entrained again, and proceeded to the Formby generating station of the L. & Y. Railway, which has been described in the ELECTRICAL REVIEW, and is also further dealt with elsewhere in this issue.

A small number, at the invitation of Dr. E. W. Marchant, Professor of Electrical Engineering at the University of Liverpool, inspected the new laboratories during the afternoon. The ladies were taken for a cruise on the Mersey, including a visit to one of the Cunard Co.'s liners.

At four o'clock the Lord Mayor held a reception at the Town Hall, and cordial sentiments were exchanged, Mr. Gray and Mr. Mordey expressing the lively appreciation of the Institution and its guests of the warm welcome they had received. Afterwards all returned to Manchester.

The following day (Sunday) was wholly devoted to travel; the special train left Manchester at 9 a.m. for Windermere, whence the party were conveyed in coaches and char-à-bancs to Grasmere. There they lunched, and after an interval for exploration, the drive was continued to Keswick. Here a halt was made for a couple of hours, and by the courtesy of the local authorities, on the initiative of Canon Rawnsley, the Museum and Southey's house were specially opened for the edification of the visitors. At 7.35 the special train, which had been brought round to Keswick, departed for Glasgow, where it arrived towards midnight. The weather, upon which all depends in a trip of this kind, most fortunately continued fair, though cloudy, and the beautiful scenery of the Lake district traversed by the conveyances was greatly admired.

(To be continued.)

THE ELECTRICAL INSTALLATION AT WARING & GILLOW'S NEW BUILDINGS.

THE opening of the now well-known Oxford Street building associated with this firm adds one more to London's commercial rendezvous.

The building covers some 40,000 sq. ft. of ground and contains seven floors, a basement and sub-basement; its construction, fitting up and decoration were carried out by the firm themselves, and both externally and internally it is a noteworthy example of the modern business establishment. Among the many interesting features of the building is the very complete electrical installation for lighting and power purposes. Energy is at present obtained from the Marylebone Borough Council's network, three triple-concentric supply feeders being led into the building; two of these which supply the lighting are connected to independent feeding points, and the third feeder supplies a power board through a 72-KW. Crompton motor-generator, as the whole of the lighting and power circuits in the building are wired for 240 volts pressure, while the Borough Council's power supply is at 480 volts pressure. These switchboards, which were built by the Lister Electric Manufacturing Co., Dursley, and the motor-generator, occupy what may eventually be an engine room in the sub-basement of the building.

The lighting feeder boards are divided into two sections, each containing two upper (switching) and two lower panels; on the one hand, the uppers and lowers are respectively connected to positive and neutral cores of the incoming feeders, while the uppers and lowers of the other section of the board are respectively connected to the neutrals and negatives of the feeders. Thus the complete failure of a main feeder only throws out of service two panels on each half of the board, and the various lighting feeders in the building can be switched over on to the other panels.

The supply cables for the lighting are connected to the boards through Chamberlain & Hookham meters and 500-ampere D.P. switches and fuses. Each lighting feeder in the building is controlled by a S.P. switch and fuse on the outgoing and a fuse on the return panel.

A voltmeter and an earth detector are mounted over each half of the lighting board. The power board is of similar construction to the others, containing four panels, two of

which are in use and the others installed for future use with an independent plant, a 300-ampere change-over switch is provided on an extra panel with this object.

Altogether 90 lighting and 14 power feeders are in use. These are run throughout in screwed iron conduit, and lead from the sub-basement in five main vertical groups, which pass up through the various floors to the top of the building.

Each floor in the building is divided into five independent sections, and each section is furthermore wired with half its lamps to each of two distributing boards situated in front of the vertical cable run. Thus it is evident that, short of a complete failure of the supply, not more than half of the lamps in the building could be extinguished at the same time. The latter feature is of enormous importance in such a huge structure, and the systematic and comparatively simple arrangement of wiring adopted was equally a necessity in this case.

A plain brass three-light pendant has been uniformly adopted for ordinary lighting work, specially made 12-c.p. Pope "Ritelite" lamps being fitted. Double (Tucker) switches are also fitted wherever possible, as, for instance, in corridors and suites of rooms, where the light can advantageously be switched on when entering, and off when leaving by another door. The switches are systematically fixed on the right hand at the point of entry, and are sunk in the wall in cast-iron boxes.

For the lighting of the Rotunda in the centre of the building, eight flame arcs (supplied by the Electrical Co.), and run four in series, are suspended above the inner glass dome, while 160 16-c.p. incandescent lamps are fitted round a cornice inside the dome.

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The handsome entrance hall is lighted by means of a dozen specially-designed pendants, supplemented by concealed "Sunlite" fittings arranged in the ceiling; and the windows, which are arranged on a novel and very effective plan of arcaded passages, also present an object lesson in effective lighting.

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Other general engineering features of the building are the low-pressure hot water system for heating the building throughout, and the P.O. telephone exchange on the sixth floor, with its 75 extensions, which, however, are controlled by the G.P.O.

As previously indicated, the question of installing a private plant is, we understand, being considered, internal combustion engines being favoured; we gather that the estimated amount of energy required per annum, is about 630,000 units.

The contractors for the electric light and power work throughout, were Messrs. Pinching & Walton, London, who carried out the work under the supervision of, and to the specification prepared by, Mr. Dumaresq (resident electrical engineer to Messrs. Waring), and approved by Mr. E. Wingfield Bowles in his capacity of consulting engineer to the firm.

In conclusion, our thanks are due to Messrs. Waring for facilitating our inspection, and to Mr. Dumaresq, who has specialised in this class of work, for kindly showing us the installation.

ELECTRIC RAILWAY FROM BONN TO COLOGNE.

L'Eclairage Electrique for May 4th, 1906, has a comprehensive article describing the equipment of this line, the greater part of which is now open. The line follows the left bank of the Rhine. It presents the interesting feature of being operated by direct current of an unusual voltage (990 volts).

The total length of the line is 17 miles; it joins existing tramway services at Cologne and Bonn. It serves Busehdorf, Hersel, Widding, Orfeld, Wessling (a future junction), Godorf, Sürth and Roden-Kirchen. Between Godorf and Wessling the line, which runs near the river, is provided with a quay at which to discharge briquettes of peat and lignite brought from the district round Bruhl into barges. The generating station and repair shops are situate in a central position at Wessling. Goods sidings have been provided at all stations in view of an anticipated carrying traffic. The passenger service is to be effected by trains of four coaches accommodating altogether 250 passengers, running half-hourly.

Three systems of equipment were under consideration for this line, the short length and junction with two lines of tramway rendering the conditions rather peculiar. These systems were:—(*a*) Proposal of the Allgemeine Elecktricitäts Gesellschaft, monophase alternating current at 6,000 volts for the country line, and 550 volts in the towns; (*b*) alternative proposal by the same firm, continuous current at 800 volts for the country line, and 550 volts in the towns; (*c*) proposal of the Siemens-Schuckert Co., 1,000 volts outside and 550 volts in the towns. This latter was adopted. The pressure is, however, referred to as 990 volts elsewhere in the article, presumably a drop of 10 allowed in feeders.

The conductors are run overhead and are double, connected by cross-pieces to which are fixed the connection for the catenary suspensions. Each conductor is of hard-drawn copper, ·12 sq. in. in cross-section. The poles supporting the wires are 155 ft. apart on the straight, closer on curves. The return is effected by the rails, bonded every 110 yds. Signal and telephone wires are laid in cable underground.

The line is divided into three sections for feeding. The Marienbourg to Surth section is fed at Surth by a feeder assisted by a battery of 330 ampere-hours capacity. There is also a booster capable of raising the voltage of the feed current by 150 volts. The second section, from Surth to Hersel, is fed from the generating station direct; and the third, from Hersel to Bonn, is fed in at Hersel, where is also a battery and a booster.

The generating station contains two sets of 350-kw. each, direct driven by compound tandem engines. There are also two boosters for feeders, and a Pirani booster for charging the battery. The action of this booster appears to be similar to the Highfield, *i.e.*, when the demand for current is large, it boosts discharge current from the battery, when there is a surplus, the booster raises the voltage of the line current to charge the battery.

Steam is generated by three boilers, furnished with economisers and filter. The fuel used consists of briquettes of lignite. An automatic system of stoking is used.

All the vehicles have Westinghouse compressed air-brakes, the compressed air being furnished by an electric compressor.

Each motor-car has two motors of 130-h.p. each, running at 700 r.p.m. The gauge of the road is 4 ft. 8½ in. (1·435 metres). The motors are four-pole with extended pole-pieces and carbon brushes.

Series-parallel controllers are used, and the multiple unit system of connecting trains.

The article quoted above gives a clear idea of the equipment of the line; it will be interesting to note how this system of moderately high tension will affect the controller gear and motors.

Installation Contracts.—The Bradford Electrical Engineering Co., have received the contract for the electric lighting of Hanson new Education Schools (Contracts Nos. 1 and 2); for a battery and switchboard for private lighting at Horton-in-Ribblesdale; also some large power contracts.

France.—La Société des Ateliers de Constructions Electriques du Nord et de l'Est is the title of a company which has just been formed in Paris with a capital of £600,000 to acquire and carry on certain electrical engineering works at Jeumont, France.

LEGAL.

OGDEN AND SMITH *v.* THE GAS LIGHT AND COKE CO.

(*Explosion in a Telephone Conduit.*)

IN the Court of Appeal on Tuesday the Lord Chancellor, the Master of the Rolls and Lord Justice Cozens-Hardy, heard an appeal by the defendants against verdict and judgment entered against them in two actions brought by Miss Beatrice May Ogden and Mr. Abraham P. Smith for damages for personal injuries sustained by them through the alleged negligence of the defendant company. The injuries were caused by explosions of gas which occurred in Regent Street on October 15th, 1903. Defendants denied their liability, and said there was no negligence on their part. It appeared that the plaintiff, Miss Ogden, was on October 15th, 1903, walking down Regent Street. When she was opposite the Goldsmiths and Silversmiths Co.'s premises there was a loud explosion. The iron cover of one of the telephone manholes was violently blown up in the air, and Miss Ogden received serious injuries and was rendered insensible. There were other similar explosions at the same time in other parts of Regent Street, and the other plaintiff, Mr. Smith, was also seriously hurt. The only question for the jury was whether the defendants could be held liable for the accident which occurred. In the event of their being held liable the amount of damages to be awarded to each plaintiff was agreed on between the parties. The Gas Light and Coke Co. were the owners of the gas mains and supply pipes running beneath the pavement of Regent Street, and gas escaped from the pipes and accumulated in the manholes of the telephone boxes belonging to the General Post Office, with the result that the explosions occurred in October, 1903. Defendants were responsible for the construction and maintenance of their gas mains and supply pipes, and were bound to remedy any leakage of gas, and to use all care that could reasonably be employed that no such leakage should take place. There were also statutory duties imposed on them by Sec. 24 of the Gas Works Clauses Act, 1847, which provided that when there was an escape of gas, after receiving a notice in writing to that effect, they were to prevent the gas from escaping. Plaintiffs' case was that the defendants were negligent in allowing the escape, and consequent accumulation of gas in the telephone boxes, and that they were liable for the injuries sustained by the plaintiffs. It appeared that Post Office telephone manholes were not ventilated, though the electric light manholes were ventilated. The immediate cause of the explosion was that a jointer in the employment of the Post Office was at the telephone manhole on the day in question doing some repairing work and using a blow lamp, when the explosion occurred. According to the evidence, a letter was written to the defendants in the preceding July on the instructions of the Post Office engineer, calling attention to the fact that there was a smell of gas in the manhole, and requesting them to see to it. The defendants investigated the matter, but failed to discover the cause. There was also evidence that other persons had for some days before the explosion noticed a strong smell of gas in the neighbourhood, and further, that it was impossible to avoid a certain leakage from the joints of gas mains, because the gas had to be forced through them at considerable pressure. The jury found a verdict for the plaintiffs in each case.

Mr. DANCKWERTS, K.C., in support of the appeal, contended that there was no evidence of negligence in the defendants to go to the jury, and even if there was, the negligence was not the *proxima causa*, or effective cause, of the accident, the effective cause being the act of the Post Office jointer in having a light at the manhole, which resulted in the explosion.

Mr. SALTER, K.C., for the respondents, submitted that the learned judge was right in leaving the matter to the jury. It was essentially a question for the jury. Everyone would admit that there were limits to the diligence and the expense which would be required by the gas company. On the other hand, whatever was right when they received warning they ought to do. Whether the company in this particular case came up to a reasonable standard of diligence in time was essentially a question for the jury. His submission was that they had proved to the satisfaction of the jury that there was a two-fold negligence on the part of the defendant company, which caused the explosion in October. In the first place, when they received statutory notice of the escape they did not act in all the circumstances with sufficient energy and thoroughness. What the company did was perfunctory and superficial. In the second place, the smell of gas was very bad, and the company ought to have known of it.

The MASTER OF THE ROLLS: Did you ever meet a gas employé who was able to smell gas?

Mr. DANCKWERTS: I think they have all very keen noses for gas.

Mr. SALTER said some of these gentlemen were asked if they could smell gas, and they declared they could, and that their noses were very efficient. It was said the telephone boxes had the effect of making an escape of gas more disastrous than otherwise might be the case, but those boxes were laid down under authority and the presence of such chambers in the immediate neighbourhood of the gas pipes, made it all the more incumbent on the gas people to carefully keep their gas under control. There was plenty of evidence on both sides that this was not a case of minute leakage. When the first complaint was made on July 31st the company ought to have done more than bore holes in the ground and use an apparently unreliable indicator. The company came to the conclusion that the General Post Office people were wrong in saying there was an escape of gas, and no further steps were taken by the gas company from July 31st to October 15th. It was true there was no report from the telephone people during that period, but the gas was smelt to a degree which was far stronger and extended over a period longer than in several of the cases where gas companies had been held liable for explosions.

The LORD CHANCELLOR, after consulting his colleagues, said they would not trouble Mr. Salter to further argue the case.

Mr. DANCKWERTS, in reply, said there was absolutely no evidence to show that there had been a large escape of gas. If there had been any large accumulation of gas the company would only have been too happy, for then there would have been no explosion. It was only because there was a minute accumulation in this close unventilated chamber for some time that an explosive mixture was set up.

The LORD CHANCELLOR, in giving judgment, said the case was one eminently for decision by the jury if there were any evidence upon which they could act. It certainly was not the function of the Court to set its opinion upon the balance of evidence against the opinion of the jury. Was there any evidence of negligence on the part of the defendants? They received a notice dated July 31st to the effect that there was a smell of gas discernible in the box. They appeared to have made some investigation and did not detect anything wrong. There was further evidence that between that date and October 15th several persons observed a strong smell of gas in this locality, and two complaints were made of it by people frequenting the houses in the neighbourhood. On October 15th the explosion took place. Mr. Danckwerts had stated the steps taken to ascertain what gas was there. The search was ineffective, but it was quite certain there must have been some inflammable material or there would have been no explosion. Subsequently, there was a further smell of gas and another explosion in June of the following year. No defects, at least none of importance, were detected in the interval. It was quite proper to admit that evidence, which was to show that there was a leakage which might perfectly well have been the same leakage which had caused the original trouble in the previous year. There was also evidence that gas in these boxes was seldom found to a dangerous degree, and there were statements that it could be prevented. The real point, to his mind, was that there was notice given to the company of the presence of gas, and ample opportunity for them to learn what others learned in the interval between August and October that gas was present and discernible by a strong smell. It seemed to his Lordship there was a duty upon the company then to put an end to whatever created that smell, which indicated danger. He thought there was evidence upon which the jury certainly were entitled to find negligence on the part of the defendants. Another point was made, namely, that there was intervention by some third party between the negligence of the defendants and the accident itself. It was said, and authority was quoted to the effect, that the negligence of the defendants in order to be subject matter of an action, must be the efficient cause of the injury. He did not know whether anybody was prepared to give an exhaustive definition of what was "efficient cause." It was impossible to define what was or what was not "efficient cause," but as he understood Mr. Danckwerts, his contention was that because this explosion was immediately caused by the application of a flame on the part of a servant of the Post Office, and because he was negligent in applying that flame to the pipe, the defendants were exonerated from their negligence in allowing the gas to be where it was to be affected by the flame. His Lordship could not believe in that contention. He thought the combined negligence of both caused the accident, but unquestionably that the defendants' negligence in allowing the gas to be there, was, if the phrase must be used, "the efficient cause." Accordingly, he was of opinion the appeal ought to be dismissed with costs.

The Master of the Rolls and Lord Justice Cozens-Hardy concurred.

The appeal was accordingly dismissed with costs.

LONDON ELECTROBUS CO., LTD.

IN the course of an application made to Mr. Justice Buckley last week, it was stated that 1,003 shareholders had applied to have their names struck off the register and their money returned. The company itself applied for the register to be rectified in this way. The number of shares affected was 48,000 out of 98,000 applied for. The order was made with certain conditions.

APPEAL DISMISSED.

ON 25th ult., says the *Manchester Courier*, the Court of Appeal dismissed the appeal of the Electric Tramways Construction and Maintenance Co., Ltd., against an order of Mr. Justice Swinfen Eady in regard to the costs of the firm of solicitors, Messrs. Miller, Peel, Hughes, Rutherford & Co., in connection with the purchase of the old Blackpool tramways, and the formation of the purchasing company.

SMITH *v.* DUBLIN AND LUCAN ELECTRIC RAILWAY CO.

PLAINTIFF secured a verdict for £150 damages in a claim heard at Dublin last week for personal injuries sustained while a passenger in one of defendants' cars in August last.

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which are in use and the others installed for future use with an independent plant, a 300-ampere change-over switch is provided on an extra panel with this object.

Altogether 90 lighting and 14 power feeders are in use. These are run throughout in screwed iron conduit, and lead from the sub-basement in five main vertical groups, which pass up through the various floors to the top of the building.

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Three systems of equipment were under consideration for this line, the short length and junction with two lines of tramway rendering the conditions rather peculiar. These systems were:—(*a*) Proposal of the Allgemeine Elecktricitäts Gesellschaft, monophase alternating current at 6,000 volts for the country line, and 550 volts in the towns; (*b*) alternative proposal by the same firm, continuous current at 800 volts for the country line, and 550 volts in the towns; (*c*) proposal of the Siemens-Schuckert Co., 1,000 volts outside and 550 volts in the towns. This latter was adopted. The pressure is, however, referred to as 990 volts elsewhere in the article, presumably a drop of 10 allowed in feeders.

The conductors are run overhead and are double, connected by cross-pieces to which are fixed the connection for the catenary suspensions. Each conductor is of hard-drawn copper, ·12 sq. in. in cross-section. The poles supporting the wires are 155 ft. apart on the straight, closer on curves. The return is effected by the rails, bonded every 110 yds. Signal and telephone wires are laid in cable underground.

The line is divided into three sections for feeding. The Marienbourg to Surth section is fed at Surth by a feeder assisted by a battery of 330 ampere-hours capacity. There is also a booster capable of raising the voltage of the feed current by 150 volts. The second section, from Surth to Hersel, is fed from the generating station direct; and the third, from Hersel to Bonn, is fed in at Hersel, where is also a battery and a booster.

The generating station contains two sets of 350-kw. each, direct driven by compound tandem engines. There are also two boosters for feeders, and a Pirani booster for charging the battery. The action of this booster appears to be similar to the Highfield, *i.e.*, when the demand for current is large, it boosts discharge current from the battery, when there is a surplus, the booster raises the voltage of the line current to charge the battery.

Steam is generated by three boilers, furnished with economisers and filter. The fuel used consists of briquettes of lignite. An automatic system of stoking is used.

All the vehicles have Westinghouse compressed air-brakes, the compressed air being furnished by an electric compressor.

Each motor-car has two motors of 130-h.p. each, running at 700 r.p.m. The gauge of the road is 4 ft. 8½ in. (1·435 metres). The motors are four-pole with extended pole-pieces and carbon brushes.

Series-parallel controllers are used, and the multiple unit system of connecting trains.

The article quoted above gives a clear idea of the equipment of the line; it will be interesting to note how this system of moderately high tension will affect the controller gear and motors.

Installation Contracts.—The Bradford Electrical Engineering Co., have received the contract for the electric lighting of Hanson new Education Schools (Contracts Nos. 1 and 2); for a battery and switchboard for private lighting at Horton-in-Ribblesdale; also some large power contracts.

France.—La Société des Ateliers de Constructions Electriques du Nord et de l'Est is the title of a company which has just been formed in Paris with a capital of £600,000 to acquire and carry on certain electrical engineering works at Jeumont, France.

LEGAL.

OGDEN AND SMITH *v.* THE GAS LIGHT AND COKE CO.

(Explosion in a Telephone Conduit.)

IN the Court of Appeal on Tuesday the Lord Chancellor, the Master of the Rolls and Lord Justice Cozens-Hardy, heard an appeal by the defendants against verdict and judgment entered against them in two actions brought by Miss Beatrice May Ogden and Mr. Abraham P. Smith for damages for personal injuries sustained by them through the alleged negligence of the defendant company. The injuries were caused by explosions of gas which occurred in Regent Street on October 15th, 1903. Defendants denied their liability, and said there was no negligence on their part. It appeared that the plaintiff, Miss Ogden, was on October 15th, 1903, walking down Regent Street. When she was opposite the Goldsmiths and Silversmiths Co.'s premises there was a loud explosion. The iron cover of one of the telephone manholes was violently blown up in the air, and Miss Ogden received serious injuries and was rendered insensible. There were other similar explosions at the same time in other parts of Regent Street, and the other plaintiff, Mr. Smith, was also seriously hurt. The only question for the jury was whether the defendants could be held liable for the accident which occurred. In the event of their being held liable the amount of damages to be awarded to each plaintiff was agreed on between the parties. The Gas Light and Coke Co. were the owners of the gas mains and supply pipes running beneath the pavement of Regent Street, and gas escaped from the pipes and accumulated in the manholes of the telephone boxes belonging to the General Post Office, with the result that the explosions occurred in October, 1903. Defendants were responsible for the construction and maintenance of their gas mains and supply pipes, and were bound to remedy any leakage of gas, and to use all care that could reasonably be employed that no such leakage should take place. There were also statutory duties imposed on them by Sec. 24 of the Gas Works Clauses Act, 1847, which provided that when there was an escape of gas, after receiving a notice in writing to that effect, they were to prevent the gas from escaping. Plaintiffs' case was that the defendants were negligent in allowing the escape, and consequent accumulation of gas in the telephone boxes, and that they were liable for the injuries sustained by the plaintiffs. It appeared that Post Office telephone manholes were not ventilated, though the electric light manholes were ventilated. The immediate cause of the explosion was that a jointer in the employment of the Post Office was at the telephone manhole on the day in question doing some repairing work and using a blow lamp, when the explosion occurred. According to the evidence, a letter was written to the defendants in the preceding July on the instructions of the Post Office engineer, calling attention to the fact that there was a smell of gas in the manhole, and requesting them to see to it. The defendants investigated the matter, but failed to discover the cause. There was also evidence that other persons had for some days before the explosion noticed a strong smell of gas in the neighbourhood, and further, that it was impossible to avoid a certain leakage from the joints of gas mains, because the gas had to be forced through them at considerable pressure. The jury found a verdict for the plaintiffs in each case.

Mr. DANCKWERTS, K.C., in support of the appeal, contended that there was no evidence of negligence in the defendants to go to the jury, and even if there was, the negligence was not the *proxima causa*, or effective cause, of the accident, the effective cause being the act of the Post Office jointer in having a light at the manhole, which resulted in the explosion.

Mr. SALTER, K.C., for the respondents, submitted that the learned judge was right in leaving the matter to the jury. It was essentially a question for the jury. Everyone would admit that there were limits to the diligence and the expense which would be required by the gas company. On the other hand, whatever was right when they received warning they ought to do. Whether the company in this particular case came up to a reasonable standard of diligence in time was essentially a question for the jury. His submission was that they had proved to the satisfaction of the jury that there was a two-fold negligence on the part of the defendant company, which caused the explosion in October. In the first place, when they received statutory notice of the escape they did not act in all the circumstances with sufficient energy and thoroughness. What the company did was perfunctory and superficial. In the second place, the smell of gas was very bad, and the company ought to have known of it.

The MASTER OF THE ROLLS: Did you ever meet a gas employé who was able to smell gas?

Mr. DANCKWERTS: I think they have all very keen noses for gas.

Mr. SALTER said some of these gentlemen were asked if they could smell gas, and they declared they could, and that their noses were very efficient. It was said the telephone boxes had the effect of making an escape of gas more disastrous than otherwise might be the case, but those boxes were laid down under authority and the presence of such chambers in the immediate neighbourhood of the gas pipes, made it all the more incumbent on the gas people to carefully keep their gas under control. There was plenty of evidence on both sides that this was not a case of minute leakage. When the first complaint was made on July 31st the company ought to have done more than bore holes in the ground and use an apparently unreliable indicator. The company came to the conclusion that the General Post Office people were wrong in saying there was an escape of gas, and no further steps were taken by the gas company from July 31st to October 15th. It was true there was no report from the telephone people during that period, but the gas was smelt to a degree which was far stronger and extended over a period longer than in several of the cases where gas companies had been held liable for explosions.

The LORD CHANCELLOR, after consulting his colleagues, said they would not trouble Mr. Salter to further argue the case.

Mr. DANCKWERTS, in reply, said there was absolutely no evidence to show that there had been a large escape of gas. If there had been any large accumulation of gas the company would only have been too happy, for then there would have been no explosion. It was only because there was a minute accumulation in this close unventilated chamber for some time that an explosive mixture was set up.

The LORD CHANCELLOR, in giving judgment, said the case was one eminently for decision by the jury if there were any evidence upon which they could act. It certainly was not the function of the Court to set its opinion upon the balance of evidence against the opinion of the jury. Was there any evidence of negligence on the part of the defendants? They received a notice dated July 31st to the effect that there was a smell of gas discernible in the box. They appeared to have made some investigation and did not detect anything wrong. There was further evidence that between that date and October 15th several persons observed a strong smell of gas in this locality, and two complaints were made of it by people frequenting the houses in the neighbourhood. On October 15th the explosion took place. Mr. Danckwerts had stated the steps taken to ascertain what gas was there. The search was ineffective, but it was quite certain there must have been some inflammable material or there would have been no explosion. Subsequently, there was a further smell of gas and another explosion in June of the following year. No defects, at least none of importance, were detected in the interval. It was quite proper to admit that evidence, which was to show that there was a leakage which might perfectly well have been the same leakage which had caused the original trouble in the previous year. There was also evidence that gas in these boxes was seldom found to a dangerous degree, and there were statements that it could be prevented. The real point, to his mind, was that there was notice given to the company of the presence of gas, and ample opportunity for them to learn what others learned in the interval between August and October that gas was present and discernible by a strong smell. It seemed to his Lordship there was a duty upon the company then to put an end to whatever created that smell, which indicated danger. He thought there was evidence upon which the jury certainly were entitled to find negligence on the part of the defendants. Another point was made, namely, that there was intervention by some third party between the negligence of the defendants and the accident itself. It was said, and authority was quoted to the effect, that the negligence of the defendants in order to be subject matter of an action, must be the efficient cause of the injury. He did not know whether anybody was prepared to give an exhaustive definition of what was "efficient cause." It was impossible to define what was or what was not "efficient cause," but as he understood Mr. Danckwerts, his contention was that because this explosion was immediately caused by the application of a flame on the part of a servant of the Post Office, and because he was negligent in applying that flame to the pipe, the defendants were exonerated from their negligence in allowing the gas to be where it was to be affected by the flame. His Lordship could not believe in that contention. He thought the combined negligence of both caused the accident, but unquestionably that the defendants' negligence in allowing the gas to be there, was, if the phrase must be used, "the efficient cause." Accordingly, he was of opinion the appeal ought to be dismissed with costs.

The Master of the Rolls and Lord Justice Cozens-Hardy concurred.

The appeal was accordingly dismissed with costs.

LONDON ELECTROBUS CO., LTD.

IN the course of an application made to Mr. Justice Buckley last week, it was stated that 1,003 shareholders had applied to have their names struck off the register and their money returned. The company itself applied for the register to be rectified in this way. The number of shares affected was 48,000 out of 98,000 applied for. The order was made with certain conditions.

APPEAL DISMISSED.

ON 25th ult., says the *Manchester Courier*, the Court of Appeal dismissed the appeal of the Electric Tramways Construction and Maintenance Co., Ltd., against an order of Mr. Justice Swinfen Eady in regard to the costs of the firm of solicitors, Messrs. Miller, Peel, Hughes, Rutherford & Co., in connection with the purchase of the old Blackpool tramways, and the formation of the purchasing company.

SMITH *v.* DUBLIN AND LUCAN ELECTRIC RAILWAY CO.

PLAINTIFF secured a verdict for £150 damages in a claim heard at Dublin last week for personal injuries sustained while a passenger in one of defendants' cars in August last.

F

PARLIAMENTARY.

L.C.C. Electric Supply Bill.

As was briefly intimated in our last issue, the Select Committee on June 28th gave a decision in the case of the L.C.C. Bill.

The Chairman said: With regard to the Bill which the Committee have considered for the last few weeks—the L.C.C. Electric Supply Bill—we have given full consideration to all the evidence and statements which have been laid before us, and, after doing so, we have come to the conclusion that in our opinion we must report to the House that the preamble of the Bill is not proved. In making that statement, I have also to say that, with regard to the instructions from the House of Commons, we have given also full consideration to a report, and have prepared a report, which is now in the hands of the printers, and will be presented to the House some time during the course of the evening. According to the rules of the House, I cannot state the purport of that report, but it is a full and exhaustive report so far as the Committee are concerned with regard to the supply of electrical energy in bulk in London and the adjoining districts, and the various parties concerned will be able to obtain that report within a very short time. In coming to the conclusion with regard to the report I am in a position to say that all of the nine members of the Committee are absolutely unanimous. I should also like to say, seeing that we have had such a long and exhaustive inquiry on behalf of the Committee and on my own behalf, that we are greatly indebted to the learned counsel, witnesses, and all who have been concerned in this prolonged inquiry for the information and assistance which has been offered to the Committee, and we beg to express our acknowledgment.

Sir R. Littler, K.C., thanked the Committee on behalf of the Bar.

The following is a copy of the report:—

The main general object of the Bill is to enable the London County Council to supply electricity in bulk to authorised distributors (that is, local authorities or companies authorised by Act of Parliament or provisional order) within the Administrative County of London and certain adjoining boroughs and districts in the Counties of Essex, Kent, Surrey and Middlesex. The Bill proposes in addition to confer on the Council powers to supply electrical energy direct to railways, docks, tramways and various other undertakings. And the Bill also proposes to confer on the Council power to transform, distribute and use electrical energy in various buildings, works or undertakings belonging to, or maintained by them, or under their control; but this power is not to apply to schools and various other buildings, parks, open spaces, pleasure grounds or workmen's dwellings, without the consent in writing of the authorised distributor. The Council do not, except as above, propose to supply electrical energy direct to any individual consumer wholly situate in the area of any authorised distributor without the consent of the authority concerned.

It is important to bear in mind that the supply of electrical energy in the Administrative County of London, and adjoining districts is now in the hands of various local authorities and companies. Powers for this purpose have been granted under the Electric Lighting Acts, and cover practically the whole of the County of London and the greater portion of the adjoining districts included in the Bill. At the present time these powers are held within the County of London by 16 local authorities and 13 companies, and with regard to most of the latter the local authorities are entitled to purchase the undertaking in the year 1931.

Tables are appended to the report showing the orders now held by local authorities and companies respectively, the areas to which such orders relate, and the extent to which competition within those areas has been authorised. A table is also given of special Acts obtained for the compulsory acquisition of land for power stations and other purposes in respect of various parts of the County of London. These tables were furnished to the Committee by the Board of Trade.

Up to the present time the capital expended by local authorities has been, in round figures, about £6,500,000 and by companies about £12,000,000, making a total capital expenditure of about £18,500,000. Capital expenditure is stated to be proceeding at the rate of about £1,000,000 a year. At the time the Electric Lighting Acts were passed, the principal question was one of light, and it was provided that, in the area of each local authority there should be a distinct and separate undertaking. No doubt this system was adopted to maintain the power given to each local authority to purchase the undertaking in 1931. The effect has been to cause a large number of separate stations to be constructed.

The Committee are of opinion that the best means of providing for the supply of electrical energy in bulk, and for power and motive purposes, is by one large and inclusive scheme extending not only over the entire County of London, but also to adjoining boroughs and districts. For the purpose of carrying out such a scheme, some central authority is required with ample statutory powers and corresponding duties. In addition to the proposal of the London County Council, various other proposals have been placed before the Committee. After giving full consideration to this question, the Committee are of opinion that the London County Council should be the authority.

The Bill before the Committee is solely permissive. No obligation is imposed on the Council to give a supply to any of the local authorities or companies; in fact, no obligation is imposed on the Council to carry into effect any of the powers sought by the Bill, and there is no prescribed time either for beginning or for carrying out the work. The Committee consider that the Council should be under such obligations, and that, under fair and reasonable terms and conditions any authorised distributor (whether a local authority or a company) should have the right to require a bulk supply. The adoption of these proposals would alter the whole scope and intention of the Bill, but it would, at the same time, make the measure more practical and effective for all purposes.

Authorised distributors made a most strenuous opposition to Clause 35 of the Bill. This is a most important clause, empowering the Council to make representation to the Board of Trade that the prices charged by any authorised distributor were excessive and ought to be reduced, or that the methods of charge ought to be altered, and after an inquiry such order was to be made as in the opinion of the Board of Trade would be fair and reasonable having regard to all the circumstances of the case, including amongst other things the terms upon which and the time within which the Council would be willing and in a position to furnish a supply.

The Committee doubt whether due consideration has been given to the fact that both local authorities and companies as authorised distributors have expended a great amount of capital in the erection and equipment of generating stations, and that this has been done, and the money borrowed under Parliamentary sanction. Any alteration of existing conditions ought to uphold in a fair and reasonable manner the interests of the authorised distributors. It was contended that the words in the clause "having regard to all the circumstances of the case" were sufficient to safeguard these interests; but the Committee consider that in such a Bill there should be contained a clear and distinct provision, so that the existing financial position and obligations of local authorities and companies as authorised distributors should be taken into account in any revision of prices, and it may be desirable that such prices when so revised should be made maximum and not actual prices.

With regard to the scheme generally the Committee are of opinion that further consideration should be given in regard to many matters pointed out during the course of the inquiry with a view to amending and improving the scheme. The distribution system proposed by the Council is one which requires further consideration. The suggestion of duplicated routes is well worthy of attention. This was proposed in the scheme of the Administrative County of London and District Electric Power Co. The trunk transmission system should be on the highest voltage consistent with safety underground and the cost of insulation.

In recommending that the County Council should be the authority, the Committee desire to refer to the statement made by Mr. Llewellyn Smith, on behalf of the Board of Trade, which they regard as of great value. The Committee have in view the fact that the County Council, as this authority, may exercise its powers in more than one way.

(*a*) The County Council may undertake the whole work, providing every authorised distributor and every private consumer with electricity in bulk at a maximum scale of prices.

(*b*) The County Council may retain for itself one part of the undertaking, while permitting a private enterprise to undertake another part.

(*c*) The County Council may lease for a substantial consideration the whole enterprise to a private enterprise to resume possession of it when its initial stages are over.

The Committee are of opinion that the report of the Finance Committee of the County Council renders desirable a careful consideration of alternative schemes.

The Committee desire to say that the scheme put forward by the Administrative County Co. appeared to be conceived on scientific lines, and calculated to afford a cheap supply of electrical energy at private risk, though it was not clear to what extent the necessary paramount authority of the County Council, and the ultimate possession of the enterprise by the Council could be secured under this scheme.

Evidence was given at length regarding the generation of electrical energy at the coalfields and the transmission of it to London at a very high voltage by overhead cables along the public roads. The Committee were not able to regard this as a suitable scheme.

The Committee visited the County Council's generating station at Greenwich. The installation (apart from the question of the method of generation) appeared to them to be in all respects admirable and to reflect credit upon the Council's engineer, Mr. J. H. Rider.

The Committee consider that the provision of cheap electric power for London is so important and pressing that they do not view with favour the possibility of the question being indefinitely hung up; they, therefore, urge that the Council should be prepared to make a decision as to their action early enough to allow other Bills to be presented for next session.

Having given full and careful consideration to all questions in respect to the Bill the Committee have determined to report to the House that the preamble is not proved.

A memorandum relating to electric power and supply Bills of the present session, which was presented to the House by the Commissioners of Works, was referred to the Committee, who considered it and took evidence upon the points raised in the Commissioners' observations. With regard, however, to all Bills introduced into Parliament during the present session in respect to electric supply in London and the adjoining districts, the Committee are of opinion that, pending the introduction of a satisfactory Bill next session by the London County Council—or, in default of the London County Council, then by some competent body of pro-

moters—it is not advisable that any further progress should be made with such Bills.

L.C.C. Tramways Bill.

This Bill came before the Earl of Camperdown's Select Committee of the House of Commons on Wednesday, June 27th.

Mr. Erskine Pollock, K.C., in opening the case for the promoters, explained that the principal proposal in the Bill was to carry the trams across Westminster and Blackfriars Bridges, along the Embankment, and so by means of an extension of the Kingsway Subway, connect up the North and South Tramway systems belonging to the Council. Counsel outlined the routes of the tramlines, and had not concluded his speech when the Committee adjourned.

Thursday, June 28th.

Mr. Pollock, continuing his opening address, said that there was not one Borough Council opposing the scheme. The City Corporation were as anxious as the Council itself to see the tramways north and south of the river connected up. Westminster, hitherto a strenuous opponent, was not opposing now, and in fact, no opposition at all came from any local authority. The District Railway, who opposed the Bill last year, had not opposed this year, the reason being that this year the tramways did not in any way interfere with the tunnels of that company.

Coming to a consideration of the petition of the omnibus companies, learned counsel said that there were no omnibuses running across Blackfriars Bridge and coming along the Embankment passed over Westminster Bridge. As to the contention that the tramlines would interfere with the general traffic, he contended that the suggestion was absurd. The petitioners went on to say that there was every possibility that motor-'buses would support electric tramways in the future.

The Chairman said that the Committee did not wish to go into the question of motor-'bus *versus* trams.

Continuing, Mr. Pollock said that the contention of the petitioners that last year one of the tramways was thrown out on finance, was absolutely unfair. Had that been the case all the tramways would have been thrown out. The petitioners asked that clauses might be inserted in the Bill so that no charge should fall upon the rates. On this, counsel pointed out that there was little fear of any charge falling on the rates. As a matter of fact, a certain sum had been paid in relief of the rates. Mr. Pollock then dealt with the petition of the frontagers, who alleged that the tramways would interfere with the free access to their premises. This, he said, could hardly refer to the Embankment, as the tramlines would be on the river side of that thoroughfare. Counsel then proceeded to deal with the petition of the Governors of St. Thomas's Hospital, and remarked that at the present time the trams were quite near the hospital.

Earl Camperdown remarked that the Committee were quite aware of that fact. The one advantage of considering such schemes as this, was that one had only to look out of the window to see what the position of affairs was.

Counsel then proceeded to explain to the Committee the position of Whitehall Court, much to their Lordships' amusement, the Chairman remarking that the members of the Committee must be given credit for living in London.

Replying to a member of the Committee, Mr. Pollock explained that only single-deck cars would be able to run through the subway, but some of these would be through cars running north and south.

Mr. Maurice Fitzmaurice, chief engineer to the Council, examined by Mr. Moon, K.C., explained to the Committee the routes of the proposed tramways, and referring to the lines of Westminster Bridge, said that starting from the junction with the existing lines in Westminster Bridge Road the new lines would pass across the road until the nearest rail to the kerb would be a distance of 2 ft. 6 in. from it. The kerb would previously have been set back 2 ft., that being the amount which the kerb would be set back on either side of the bridge. The average width of the Embankment was 54 ft. between the kerbs. Of that 18 ft. would be taken up by the trams, including the 2 ft. 6 in. to the kerb, and the overhanging of the cars. The junction at Waterloo would be a double junction, and in order to bring this about a deviation of the authorised route of the subway would be necessary. The subway would be a slight incline from the Embankment to the Strand—1 in 3,000—so that it might be considered to be level. Just were the lines came on to the Embankment, the incline would be steeper—1 in 39. That would be for a length of 200 ft. Witness then dealt with Blackfriars Bridge, and the Chairman interposed at this point, and said that it might be convenient if the Committee heard the Corporation's Bill before they gave a decision on tramways. Mr. Moon concurred.

Mr. Vesey Knox said that he appeared with his friend Sir Ralph Littler, and would be very glad to go on with the Corporation's Bill when the Committee desired.

The question of opposition to the Bill then arose, and after consultation, it was found that the Metropolitan Water Board was opposing the Corporation's Bill. The agents were informed of what the Committee had suggested.

Mr. Fitzmaurice's examination was then continued by Mr. Erskine Pollock. Witness said that the width of the roadway in Blackfriars Road at the junction with the existing tramways was between 54 ft. 7 in. to 56 ft. The estimates for the different lines were as follows:—Tramways Nos. 12 and 12A, £23,000; 13, 13A and 13B, £61,700; 14, £2,600. The total engineering cost would be £87,000.

Cross-examined by Mr. Lewis Coward, K.C., Witness said that he did not think the cars would greatly interfere with the traffic on Westminster Bridge. Witness was questioned as to the weight of the cars, and said that they weighed about 16 tons each.

Mr. Coward: And you know that it is proposed to take the cars over in "bunches of four"; won't that be a heavy strain on the bridge—64 tons at once?—Mr. Fitzmaurice: No, it will be quite safe.

Mr. Coward: Then why have you got the following notice on the approaches to the bridge: "No locomotive or steam-roller which brings a greater load than 2½ tons on any wheel shall go on or pass over this bridge?"—Witness said that that notice was on all the bridges under the control of the London County Council. The weight of the tramcars would be distributed over a greater area of the bridge.

Mr. A. L. C. Fell, the Council's tramways manager, and Mr. Harper, the statistical officer to the Council, both gave evidence as to the probable number of passengers who would be carried.

Monday, July 2nd.

Mr. Stephen Sellon, M.I.C.E., was called on behalf of the case for the frontagers on the Embankment. Examined by Mr. Tyldesley Jones, witness said that, in his opinion, the proposals in the Bill were unsatisfactory. He took the view that the proposed tramways across Westminster Bridge would largely increase the present congestion of the traffic. Mainly his objection was on account of the lines being placed on the down-river side of the bridge.

Mr. Jones: Just to make your position clear, you are not, I believe, personally opposed to tramways over the bridge?

Witness: Oh, no; I am absolutely clear that they must go over the bridge. I submitted a large scheme of tramways for the Traffic Commission to consider in which these bridges were the ones I showed the tramways must cross, so as to get the north and south connection. Continuing, he said that he wished to give the Committee, shortly, the effect of bunching at Westminster in the manner which had been described by one of the witnesses for the L.C.C. There was a distance of 240 yds. on the east side of the bridge, within which no car might stop to pick up or set down passengers.

Mr. Erskine Pollock objected that the distance was subject to alteration by the police. There would be an elasticity.

Witness agreed. Unless the distance was reduced no car would be allowed to stop within the 240 yds. Each car was 32 ft. 6 in. in length, which gave a total length for four cars of 130 ft. Then there would be a distance of 50 ft. between each car, making a total length of 280 ft. from the commencement of the first car to the end of the last car. A bunch of cars 280 ft. long travelling at 8 miles an hour would take two-fifths of a minute to cross any given point, so that, taking one minute as the time occupied by the first car starting from the end of the 720 ft., or 240 yards, to reach the bridge, the traffic would have to be held up for at least 1⅔ minutes. That was with cars going at 8 miles an hour. It meant that for three minutes the tramway traffic at the point where it crossed the line of the road traffic would be occupied either in passing one bunch of cars, or else in allowing the road traffic to cross that point.

Mr. Jones: At the end of the three minutes—that is to say, three minutes after the previous bunch started across the bridge—you are ready to send another bunch across?

Witness: Yes; and by the time I am ready to send on that bunch of four cars, as the cars run two a minute, I have got six cars at the terminus instead of four.

Mr. Jones: That is to say, that at the end of every three minutes, when you are in a position to send across this bridge four cars, six cars will have arrived at the terminus?—Yes, at the end of this three minutes; so that at the end of an hour, if that mathematical proportion continues, you will have a line of tramcars down the road to the extent of 40 in number.

Witness's conclusion was that cars must accumulate every two or three minutes, and this would greatly add to the congestion. He did not think the same effect would occur at the Waterloo Bridge junction or the subway.

Witness was then taken at some length into the question of the keeping of accounts of their tramways undertakings by various Corporations, the intention being to show that the L.C.C. had not set aside enough for depreciation and renewals. Glasgow, he said, charged themselves in their revenue account with 2·05d. per car-mile, and in addition to that set aside for reserve, a sum equal to £62,000. Witness also criticised the Council's estimated working expenses and receipts. From an æsthetic point of view the tramways would be objectionable, but his great point as a tramway man was this:—It was difficult to see how this tramway along the Embankment could possibly end but in a very sad loss to the ratepayers, because the Council had assumed that they would take as much or more on the Embankment line as they would do on any of their other lines. If there was a line on the Embankment connecting various lines from the South like a fan—all those lines converging on to one point at Westminster Bridge, and the whole of that traffic taken over Westminster Bridge—to make it pay there must on every one of the cars be a capacity of 1s. per car-mile.

Witness was cross-examined at some length by Mr. Erskine Pollock, K.C. (for the L.C.C.), who endeavoured to get witness to admit that the Council's estimate of 7d. per car-mile would pay. Mr. Sellon would not agree.

Mr. Thomas Tuff, traffic manager to Messrs. Tilling, was then called on behalf of the opposition of the Omnibus Co., and said that there could be little doubt that great inconvenience to the

Council should be the authority.

London County Council, then by some competent body of pu

general road traffic would result if the proposed tramways were made.

Tuesday, July 3rd.

Evidence was given on behalf of the police by Superintendents Novice and Beard. The former dealt with the question of the traffic on the south side of Westminster Bridge, and the latter with that on the north, or Embankment end. Superintendent Beard said that the police did not apprehend any difficulty with the trams either at the junction of the Embankment and the bridge, or at the proposed junction with the subway which will come out under Waterloo Bridge. Superintendent Novice also thought that there would be no difficulty either at Westminster Bridge Road or the south side of Blackfriars Bridge. The opening of the new Vauxhall Bridge, said Superintendent Novice, had relieved the traffic across Westminster Bridge, and he did not anticipate that the police would have any difficulty in regulating the traffic should the tramway be sanctioned. Both witnesses said that undoubtedly the proposed tramways would give the police a little more work, and would involve the employment of a few more constables.

Mr. Hutchinson, addressing the Committee on behalf of the frontagers, suggested that if the trams were to come across Westminster Bridge, the footways of that bridge should be reduced to 11 ft. 6 in., and the tramlines be placed in the centre of the roadway, with a distance of 7 ft. between each track. As to the capital cost of the scheme, it appeared that in addition to the £146,000 which had been stated as the amount of that cost, there would be a sum to be paid to the City Corporation for reimbursement for constructing the tramway over Blackfriars Bridge.

Earl Camperdown said that he understood that the Council was to pay a rent on that tramway. Had they to pay anything towards the cost of the widening?

Mr. Moon, K.C. (for the L.C.C.), said that the basis of the settlement had not been arrived at.

Mr. Hutchinson pointed out that it had previously been stated that the Council would be called upon to pay a rent on part of the capital charge of widening the bridge, as well as to pay for the construction of the tramway. His point was that the cost of the construction of the tramways would be more than the £146,000.

Wireless Telegraphy in the Army.—In Friday's Parliamentary Papers Mr. Bellairs asked the Secretary of State for War what system of wireless telegraphy is being adopted for the Army, and whether the Navy using Marconi apparatus are free from any agreements or impediments as regards intercommunication between the two systems. Mr. Haldane replied as follows:—"The War Department are experimenting with the Lodge-Muirhead and another system, but are not committed to the exclusive adoption of either. The Admiralty may not communicate from Admiralty shore stations in the United Kingdom by Marconi's system with any other system used by the War Department, except during war time or case of emergency. But there would be no technical difficulty in such communication."

Electric Lighting Provisional Order (No. 7).—On Thursday last week a Select Committee of the House of Commons, presided over by Mr. Toulmin, sat to consider Electric Lighting Provisional Order (No. 7) Bill concerning which opposition had been notified to the Stourport and Kidderminster Order by the Stourport Urban District Council, and to the Barton-upon-Irwell Order by the Manchester Corporation. On the Bill coming before the Committee, it was notified that the opposition had been withdrawn, and accordingly the Bill was referred to the Unopposed Bill Committee.

Second and Third Readings.—In the House of Lords on June 28th the following Bills were read a third time:—North and South Shields Electric Railway Bill, Brixham Gas (Electric Lighting) Bill. In the House of Commons on Monday the Nottinghamshire and Derbyshire Tramways Bill was read a third time, having already passed the Lords. The following were read a second time, having already passed through the Lords:—County of Durham Electric Power Supply Bill, Newcastle-upon-Tyne Electric Supply Bill. In the House of Lords on Monday the Derbyshire and Nottinghamshire Electric Power Bill was read a second time. The Metropolitan Railway Bill passed third reading. In the House of Commons on June 27th the Folkestone and District Electricity Supply Bill was read a second time.

Brakes for Tramcars.—In the Parliamentary papers on 28th ult. Mr. T. Davies asked the President of the Board of Trade whether his attention had been drawn to the accident which occurred to an electric tramcar near Highgate Archway on the previous Saturday, resulting in the death of several persons; and whether, in view of similar accidents of late to cars on steep gradients, he would consider the advisability of instituting an inquiry in order that he might, if necessary, make more stringent regulations as to brakes of cars running over very steep gradients such as this. Mr. Lloyd-George, in reply, said:—An inquiry into this sad accident will be held on behalf of the Board of Trade by the chief inspecting officer of railways, and the question to which my honourable friend draws attention will certainly receive very careful consideration.

INTERNATIONAL ELECTRO-TECHNICAL COMMISSION.

In September, 1904, towards the close of the International Electrical Congress at St. Louis, a resolution was unanimously adopted by the Chamber of Government Delegates that steps should be taken to secure the co-operation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardisation of the nomenclature and ratings of electrical apparatus and machinery. The president of the American Institute of Electrical Engineers was asked to take charge of the matter on the other side of the Atlantic, and Colonel Crompton was appointed to deal with the countries on this side of the water.

After considerable correspondence with most of the existing electro-technical societies, and in those countries in which electro-technical societies did not exist, with their governments, most of the countries evinced considerable interest in the matter and agreed to send delegates to a preliminary conference to be held in London on June 26th, 1906.

In November last our Institution of Electrical Engineers appointed an Executive Committee, under the chairmanship of Mr. Alexander Siemens, to draw up a set of proposed rules and to prepare the necessary steps for the preliminary meeting in London. In addition to Mr. Alexander Siemens, Sir William H. Preece, K.C.B., Colonel R. E. Crompton, C.B., Mr. John Gavey, C.B., Dr. R. T. Glazebrook, Mr. R. K. Gray, Mr. Charles P. Sparks, and Mr. C. H. Wordingham were members of the committee. After several sittings a set of draft rules were prepared and circulated to the countries which had signified their intention to send delegates.

This preliminary meeting was held at the Hotel Cecil on Tuesday, June 26th, with Mr. Alexander Siemens in the chair. A list of the delegates and the authorities by whom they were appointed is given below.

The draft rules by which the organisation and work of the Commission is to be regulated were very carefully considered. Several important amendments were introduced, and at the adjourned meeting on Wednesday, June 27th, the meeting finally adopted the rules, subject, of course, to ratification by the authorities by whom the delegates were appointed. Until this ratification has been obtained, the rules cannot be published, but as they were prepared by the joint efforts of the leading members of the Electro-technical Societies of so many countries, they cannot fail to be of an absolutely fair and equitable character.

Great care has been taken to prevent the Electro-technical Commission being in any way hampered by Government control; the work is to be directed by the Council of the Commission and the local committees directly under the several technical societies.

At the meeting, Lord Kelvin was unanimously elected the first President of the Commission, and Col. Crompton was appointed as the first honorary secretary.

It is intended that the work of the Commission shall proceed by correspondence, and that the efforts of the Commission will be addressed, in the first instance, to the standardisation of nomenclature, so that the electro-technical terms used shall be common to all countries, and it is hoped then that a similar standardisation of physical formulæ, which must be equally common to all countries, may be reached.

One advantage of the work being international will be that every country will, no doubt, contribute its quota to the general fund of knowledge which already exists, on the behaviour of the materials used by electrical engineers when subjected to mechanical and electrical stresses, and in this respect the countries who have made the greatest progress will assuredly willingly put their experience at the disposal of those who are later in the field.

List of Delegates:—

America (Institute of Electrical Engineers):—Dr. F. B. Crocker; Dr. A. E. Kennelly; Mr. C. O. Mailloux.

Austria (Elektrotechnischer Verein in Vienna):—Prof. Karl Pichelmeyer; Dr. E. Rosenberg.

Belgium (Société Belge d'Electriciens):—Dr. R. B. Owens; Mr. L. A. Herdt.

France (Société Internationale des Electriciens):—Prof. Paul Janet; Mons. Paul Boucherot; Mons. C. David.

Germany (Verband Deutscher Elektrotechniker):—Dr. E. Budde; Herr G. Dettmar.

Holland (Koninklijk Institut van Ingenieurs):—Prof. E. Feldmann; Mons. W. Smit.

Hungary (Minister of Commerce):—Mons. Joseph Vater; Mons. D. Harsanyi.

Italy (Elettrotec. Italiana):—Prof. L. Lombardi; M. Guido Semenza.

Spain (Spanish Government):—Prof. Juan Alonso y Millan; Prof. Blas Cabrera Felipe.

Japan (Denkigakukwai (Electrical Society of Japan)):—Dr. Ichisake Fujioka.

Switzerland (Association Suisse des Electriciens):—Prof. J. L. Farny; M. K. P. Tiuber.

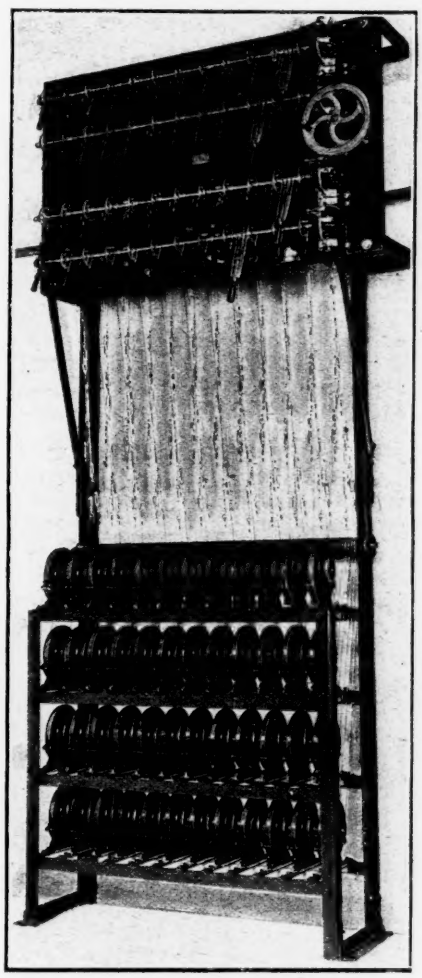
Norway, Sweden, Denmark, Argentine, Mexico:—Not yet appointed.

Italy.—La Societa Italiana per Conduttori Elettrici Isolati e Prodotti Affini is the name of a company which has just been formed at Leghorn, with a capital of £48,000, to manufacture electric conductors.

Clacton-on-Sea.—The L.G.B. has consented to the Council purchasing Mr. Ainslie's private E.L. plant and goodwill for £1,000.

BUSINESS NOTES.

Large Theatre Dimmer Installation.—The Cape Town Theatre is about to have one of the most complete installations of dimmers that has yet been erected. It is a four-colour "Wirt Universal" installation of the latest improved pattern. The theatre is wired for 48 circuits, varying from 10 to 20 lights, and the improved combination enables each circuit to be controlled independently of any other, and any desired number of the circuits to be interlocked on a driving shaft, so that any number of circuits can be raised or lowered by a single operation in the same or contrary directions, and by quick or slow motion. The dimmers are mounted on stands and driven by steel cords arranged so as to leave the operating board entirely dead, even in the event of any part of the dimmer frame being alive. The dimmers are of the jointless mica-insulated Wirt construction, the resistance in each case being a single tapered ribbon, the folds being insulated with mica. The



Cape Town Theatre Dimmer Installation.

coils, placed between mica sheets, are gripped and held in position by steel plates secured by a steel band spun over the edge. In this way the faults which are caused by the cracking of enamel or artificial stone, or the action of absorbed moisture on the resistance ribbon, are wholly avoided, and the dimmers, though rated to run cool, are capable of withstanding without injury very heavy overloads and sudden heating and cooling. The operating gear is mounted on a polished slate board, all holes being bushed with ebonite. Motion is made by a worm on a vertical shaft, which, by means of gun-metal clutches, can be thrown into gear with one or more of the horizontal shafts carrying the operating levers. The sole licensees and makers of the Wirt dimmers and rheostats for Europe and the Colonies (except Canada) are Messrs. J. Defries and Sons, Ltd., 147, Houndsditch, London.

Price War in German Batteries.—A bold move has been taken by the Accumulator and Electricity Works Co. (late W. A. Bose & Co.) which has fixed the rebates on all classes of stationary accumulators at 30 per cent., as compared with a rate ranging from 20 to 22 per cent. which has hitherto been in operation. This step is directed against the Berlin-Hagen Accumulator Works Co., which practically controls three-fourths of the trade in stationary batteries in Germany. As mentioned in these columns several months ago, the Berlin-Hagen Co. has reached a very strong position partly as a result of the gradual absorption of rival undertakings and financial participation in others, and partly in consequence of agreements which exist between it and the principal electrical manufacturers. It is this position which the Bose Co., which is the only competitor of importance now remaining in the trade, has ventured to assail. The directors of the company believe that the future of the undertaking depends upon an extension of the stationary battery department, and that the present reduction in prices by increasing the rebates has been entered upon without any particular risk, especially as the total expenses will be met by the other branches as represented by the departments for portable batteries, electric lighting of railway and other carriages, and for heating installations. It remains to be seen what measure of success will attend the company's action. In the meantime the prospect may be said to be far from encouraging as apart from the agreements which exist between the Berlin-Hagen Co. and the principal manufacturing firms in regard to stationary batteries for central station and other work, the former company has other agreements with installation contractors who, in consideration for the grant of rebates of from 15 to 20 per cent., place themselves under the obligation to entrust all their orders for the class of battery in question to the Berlin-Hagen Co. In certain cases contractors may be justified in using batteries of other makes if specially ordered by contractors' clients, but in all instances of this kind the contractors are bound by the agreement to inform the Berlin-Hagen Co., prior to acting upon the instructions, so that the latter company may endeavour to induce the buyers only to use its manufactures and not those in contemplation.

Increase in Prices in Austria.—The principal manufacturing firms in Austria-Hungary, who raised prices by 10 per cent. at the beginning of January, have now resolved to make a further increase of 5 per cent., making a total advance of 15 per cent. Although the direct reason for the rise is to be found in the greater cost of raw materials, a further cause is said to lie in the progressive concentration in the electrical industry. This movement commenced two years ago with the fusion of the Austrian firms of Siemens & Schuckert, and then the amalgamation of the Austrian Allgemeine Co. and the Union Co. took place, while the community of interests established between the latter group and the electrical interests of Ganz & Co. forms a fresh link in the chain. In addition to this, a further stimulation of the increase in prices exists in the large advance in the German import duties on electrical materials which took place on March 1st.

Annual Outings.—The London Electrical Fittings Co. and the Wandsworth Co. had their annual outing last Saturday, and journeyed to the Roebuck Hotel, Tilehurst, Mr. Denning, in the unavoidable absence of the Messrs. Galsworthys, presided, and proposed the continued success of the London Electric Co.; Mr. Blower responded for the "Wandsworth Co.," and Mr. Barnes replied for "The Visitors." The afternoon was spent on the river.

Ealing Corporation electricity department went for their third summer outing on Saturday, June 23rd. Some 40 strong, they journed to Westerham, Kent, where a long programme of sports was carried out. Mr. J. Douglas Knight, borough electrical engineer, presided at the dinner, held at King's Arms Hotel. The cost of the dinner was borne by Mrs. Douglas Knight. A cricket match "Insides *v.* Outsides," followed, the former beating the latter by 49 to 44. A silver cigarette case, subscribed for by the staff and employés, was presented to Mr. F. L. Moore, as a token of appreciation of his services as bandmaster of the works' band.

On Saturday last the employés of the arc and incandescent lamp departments at the Victoria Works of the Sir Hiram Maxim Electrical Co., travelled by special train to Worthing for their annual outing. The local institute had been hired for the occasion by the company as the party's headquarters, and immediately on arrival, all sat down (under the chairmanship of the works manager, Mr. A. W. Hill, supported by the whole of the staff) to luncheon. At tea-time a little speech-making was indulged in, the chairman reading a communication from the secretary regretting the inability of the board to be present. The letter stated that the prospects of the company for the future were exceedingly good, and with the work already on hand, they looked forward to a busy and prosperous year.

The Tunbridge Wells electricity works staff went for their annual outing on Wednesday last week to Portsmouth. The Dockyard, gun wharf, and electric light and tramway undertaking, were among the attractions visited. Mr. Horace Boot, chief electrical engineer, accompanied the party.

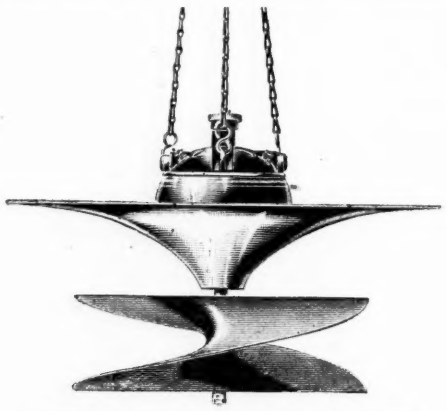
The employés of the King's Road and Stanhope Street electricity generating stations of the St. Pancras Borough Council visited Portsmouth on Saturday last, on the occasion of their annual outing. Dinner was held at the Handy Man Restaurant, with Mr. H. E. Cooper in the chair. A hearty vote of thanks was passed to Messrs. S. W. Baynes, chief electrical engineer; J. T. Baron, resident engineer; T. W. Merry, chief assistant; and H. E. Cooper, engineer-in-charge, for their kindness in sending donations. In the course of the toasts, the secretary of the outing, Mr. J. H. Chandler, was heartily thanked. The rest of the day was spent in sight-seeing, and included visits to the *Victory*, H.M.S. *Barfleur*, four submarines, &c., all lying in the harbour, the neighbouring towns of Southsea and Gosport, and other places of interest in the neighbourhood.

The employés and friends of the Aberdeen Corporation electricity works held their annual outing on Saturday. It took the form of a drive along the south Deeside Road to Bridge of Park,

returning by Oulter, where the party had tea. Dancing and sports were afterwards engaged in.

The Veritas Athletic Club (some 200 or 300 strong), drawn from the staff of Messrs. Falk, Stadelmann & Co., Ltd., of Farringdon Road, E.C., held their fourth annual athletic meeting, on Saturday last, at the High Beech Track. Messrs. Max Falk and Louis Thurnader, two of the directors, assisted throughout a long programme, Mr. Falk afterwards presenting the prizes.

Freezor Fans.—The General Electric Co., Ltd., of London, E.C., have just issued from the press the 1906 edition of their catalogue of "Freezor" electric fans. A number of the designs embody improvements effected since the issue of the last list. A new line that has been introduced is the ceiling fan with



New Freezor Fan with "Truss" Blades.

"Truss" patent blades. The air is drawn upwards instead of being blown down, and smoke is claimed to be disintegrated not distributed. These fans are specially recommended for the smoking rooms of clubs and hotels. The principle is illustrated in the accompanying figure. Considerable reductions are noted in the prices of a large number of the fans included in the list.

Trade Announcements.—Mr. E. Arnold Pochin announces that his new works in Trafford Park are now complete and are fully equipped for the manufacture of machine-cut gearing upon an extensive scale.

Messrs. Hunter & Swan, of 1, James Street, Bute Docks, Cardiff, have been appointed representatives in South Wales for the Brush Electrical Engineering Co.'s manufactures, consisting of steam-electrical plant, rolling stock for electrical and steam lines, &c.

Mr. Alfred Ingram announces that he has severed his connection as carriage and wagon superintendent with the Metropolitan Railway Co., for whom he designed their new electric rolling stock, and has opened offices at Queen Anne's Chambers, Westminster, as Alfred Ingram & Co., for the supply of all materials for railway and electric traction purposes.

The Aron Electricity Meter, Ltd., will be removing on July 16th to their new premises, 80A, Salusbury Road, Kilburn, N.W., where business will be carried on as usual.

Dissolutions and Liquidations.—South American Light and Power Co., Ltd.—A petition for confirming the reduction of the capital from £100,000 to £50,000, will come before the Courts on July 10th.

Williamson & Joseph, Ltd.—A meeting is to be held at Broad Street House, E.C., on August 1st, to hear an account of the winding-up from the liquidator (Mr. Theo. Taunton).

Catania Electric Lighting and Tramways Co., Ltd.—A meeting is to be held at 4, Adelphi Terrace, Westminster, on July 31st, to hear an account of the winding-up from the liquidator (Mr. A. J. Lawson).

Llandudno and Colwyn Bay Electric Traction Co., Ltd.—At a meeting held on June 26th, it was resolved to wind up voluntarily with Mr. John Morris, 33, Brazennose Street, Manchester, as liquidator.

For Sale.—The G.P.O. is offering old stores for sale, as stated among our advertisements to-day.

Tender Prices in Germany.—The firm of A. Gobiet and Co., of Cassel, have issued a circular complaining of the monopolistic attitude of the large electrical manufacturing works, which at present, it is alleged, act in unison in cases of orders of the value of only £500, as compared with £2,000 until recently. The complaints, which specially relate to contracts thrown open to tender, have evoked a reply from one of the Berlin firms. It is admitted in reply that for the past two years arrangements have been made for the purpose of limiting the cutting of prices, but a general understanding between the electrical manufacturing firms has hitherto not been carried into effect. Down to the present time it has only been possible to arrive at understandings in individual cases, although these have not only been come to between the large firms, but also with all the firms in general in so far as they have been so disposed. It is denied that punishment is meted out to the *personnel* for the loss of contracts.

Book Notices.—"Science Abstracts." Parts A and B. No. 102. June 25th, 1906. London: E. & F. N. Spon, Ltd. 1s. 6d. each net.

"Fire Tests with Floors." Red Book No. 106 of the British Fire Prevention Committee. London: The Committee. 2s. 6d. net.

"British Standard Specification for Structural Steel for Bridges and General Building Construction." Report No. 15 of the Engineering Standards Committee. London: Crosby Lockwood and Son, or the Committee's offices. 2s. 6d. net.

Messrs. Whittaker & Co. will shortly publish a new book on "Polyphase Currents," by Alfred Still, M.I.E.E. In this book the author has adapted a non-mathematical treatment of the subject, and gives the principles underlying polyphase working.

Bankruptcy Proceedings.—J. M. Vaughan, electrical engineer, Knowle, Bristol.—July 18th is the last day for receiving proofs for intended dividend. Trustee, Mr. F. L. Clark, 26, Baldwin Street, Bristol.

Catalogues and Lists.—Messrs. Baxendale & Co., Manchester.—Illustrated and priced circulars relating to their automatic temperature regulator for use in conjunction with electric fans, ornamental switches and switch plates, and table, porthole, suspension, cabin and other pattern electric fans for the 1906 season.

Messrs. Crompton & Co., Ltd., London, E.C.—A handy (64-pp.) pocket catalogue, being an abbreviated price list of Crompton arc lamps, continuous and alternating current dynamos and motors, instruments, switchgear and circuit-breakers. Publication No. U 13 gives full particulars, with diagrams, prices, code words, &c., of electrical instruments for continuous current circuits.

Sun Electrical Co., Ltd., London, W.C.—Illustrated catalogue (21 pp.) giving particulars, prices and views of their electric motor fans for a variety of purposes for the current season. A four-page circular has also been issued showing and pricing a number of cheap stock selling lines in electric fittings.

Sterling Telephone and Electric Co., London, E.C.—Pamphlet (No. 126) relating to their battery wall telephone with buzzer.

British Westinghouse Electric and Manufacturing Co., Ltd.—16 pp. brochure entitled "Electric Driving in Textile Mills," containing a well-illustrated account of this kind done by the company in mills at Saltaire and Bradford, and briefly summarising the advantages of electric driving in textile industry.

The Electrical Co., Ltd., London, W.C.—New publication (leaflet No. 209) giving a few particulars with illustrations and notes of prices of their patent controller finger.

The General Electric Co., Ltd., London, E.C.—New souvenir booklet just issued entitled "The History of a Great Electrical Undertaking." An illustrated description of the company's Witton Works, the Peel Works at Manchester, the Art Metal Works at Birmingham, the Robertson Lamp Works, and the various premises in London is given, together with some general notes concerning the rise and progress of the company.

LIGHTING and POWER NOTES.

Bargoed.—The Rhymney Valley and General Electric Supply Co., on June 27th, applied to the Gellygaer and Rhigos U.D.C. for consent to its application to the B. of T. for a prov. order enabling it to supply electricity to Bargoed and district. The Council decided to support the application.

Barking.—At a meeting of the T.C. last week it was stated that there was a deficit of £557 on the year's working of the E.L. undertaking. In order, if possible, to increase the number of users the Council has reduced the price of current for lighting to 4d. per unit, with the following rebates on prompt payment of accounts:—1,000 to 10,000 units per quarter, 2½ per cent.; beyond, 5 per cent.

Birkenhead.—The Corporation electricity accounts for the year ended March last, show a gross profit of £9,073. After paying financial charges and interest, &c., a surplus of £2,210 remained, as against £2,109 in 1904-5. This sum was added to the renewals fund, raising that fund, with interest on investments, &c., to £6,862. The capital expenditure during the year was £3,494, and the debt on March 31st, £108,105.

Bradford.—In connection with its electricity undertaking the past year has been a very disappointing one to the Bradford Corporation. In place of the £8,709 net profit shown in 1905 there is now one of £3,568 only, in addition to which the renewals fund has been reduced by £17,244, making the figure at which it now stands £10,545. Out of this there has to be provided a sum of £4,000 to meet expenditure on repairs during the coming year. Moreover, in the balance-sheet now issued no allowance is made for general depreciation, though £16,527 has been taken for special depreciation from accumulated funds. The following is a summary of the balance-sheet for the year 1905-6, which was sub-

mitted to the Electricity Committee at its meeting on Friday last, with the corresponding figures for the year ending March 31st, 1905:—

Income from sale of energy—	1904-5.	1905-6.
General supply	£51,983	£54,454
Tramway supply	36,182	36,969
Public lighting	656	662
Distribution	1,904	2,049
Motor and arc lamp hiring	4,221	3,954
Total income	£94,946	£98,088
Total expenditure	45,022	47,478
Gross profit	£49,924	£50,610
Interest allowed	554	411
	£50,478	£51,021
Interest, sinking fund, &c.	41,781	47,459
Net profit	£8,697	£3,562

The gross capital expenditure to March 31st, 1905, was £618,921, and to March 31st, 1906, £727,294, an increase of £108,373 in the 12 months. Sales during the past few years have increased slowly, as the following figures show:—

Total sales in 1904	12,570,618 units
,, ,, 1905	13,733,651 ,,
,, ,, 1906	13,984,054 ,,

The greater part of the present output is used for tramway traction.

The report says that an increase of capital by £108,000 has been responsible for the heavy increase in the interest and sinking fund charges. The balance of unappropriated profits stood at £19,158 at the end of last year. That has now been reduced to £2,631 by special depreciation of hired motors and arc lamps ordered by the committee, and amounting to £7,925, and by writing off the balance of the cost of the six marine boilers and a boiler feed pump, amounting to £5,670. The statement of output shows a small increase on private lighting account, and an actual decrease in the receipts for motive power, as compared with 1904-5. The greatest increase is on tramway account. The terms on which energy is supplied for tramway traction are receiving consideration. It is said to be under cost, and that a higher scale will be laid down. What seems to be most needed is some means of stimulating the private demand.

Bridlington.—The T.C. has received from the L.G.B. sanction for a loan of £2,558 for electricity purposes, £400 being for meters.

Brighouse.—The T.C. has decided to extend the plant at the electricity works by the addition of another generating set.

Canada.—Barrie, Ont.—The municipality has decided to enlarge its E.L. plant at a cost of $27,000.

Port Hope, Ont.—A vote of the electors is to be taken on July 4th on the question of establishing a municipal electric street lighting service. Should the inhabitants agree to the scheme, a sum of $7,400 will be borrowed for the undertaking.

Brandon, Man.—The Great Western Power and Manufacturing Co., of Peterborough, Ont., will shortly install a $200,000 plant for the generation of gas and electric light.

Niagara Falls.—The City Council has decided to ask the Ontario Government for permission to develop 10,000 H.P. to run its electric light and waterworks plant and provide a surplus for an emergency.

Montreal.—The Montreal Light, Heat and Power Co. has, after exhaustive tests, adopted the Westinghouse wattmeter, and placed an order for 2,100 of these with the Canadian Westinghouse Co. at Hamilton.

Cheshunt.—The U.D.C. has sealed an agreement with the North Metropolitan Electric Power Distribution Co. for E.L. in the district.

Chorley.—The B. of T. has revoked the 1898 electric lighting order.

Continental Notes.—Italy.—The Prefecture of Coni has granted to M. Louis della Beffa, Milan, a concession for deriving power from the river Varaita in the district of Sampeyre for electric lighting, traction and mining purposes. The estimated cost of the works is £68,320. The "Société des Forces Hydrauliques du Haut Po" has also obtained rights on this river for electric lighting and industrial purposes in the neighbourhood of Saluces and Pignerol. Estimated cost, not including machinery, £20,000. Permission from the Prefecture of Sondrio has also been obtained to utilise the water power from the Mailero torrent for the generation of electricity for lighting purposes. M. Joseph Foà, acting for the "Société Italienne pour l'Industrie des Tissus Imprimés," has obtained from the Prefecture of Novarro concessions for the derivation of water power from the Strona di Omegna.—*Board of Trade Journal.*

A concession for the erection of a water-power plant on the River Degano has been granted by the Udine municipality.

Germany.—The Rheydt municipal authority has decided upon the extension of its electric lighting station at an estimated cost of £60,000.

Exeter.—The City Council on the 2nd inst. approved the scheme of public lighting by electricity referred to in our last week's issue. The following table was submitted showing the comparative cost of lighting by electricity and gas on the tramway routes (including Alphington extension), now lit by gas, in the streets along which electric cables are laid, and also for 10 lamps of 400 C.P. each:—

	Electricity.	Gas without controllers.	Gas with controllers.
Annual cost	£1,971	£1,722	£1,540
Cost of conversion ...	£1,368	£1,251	£2,048
Annual charge for first five years	£2,244	£1,972	£1,950

The latter charge is made on the assumption that the cost of conversion is spread over such period.

Williton.—The R.D.C. has received from the Minehead Electric Supply Co. an intimation that the latter intends to apply to the B. of T. for a prov. order for E.L. in the parishes of Minehead Without and Dunster. The Council has decided to take no action in the matter.

Fenton.—Before confirming an agreement with Stoke-on-Trent T.C. for the supply of electricity, the U.D.C. has decided to ascertain whether Stoke is prepared to pay the costs incurred by Fenton, incidental to the application for the necessary prov. order to supply the district.

Flixton.—As stated in a recent issue of the Electrical Review, the P.C. decided to ask the B. of T. if there was any higher authority to whom it could appeal against the Board's decision to grant a prov. order for E.L. to the Barton-upon-Irwell R.D.C., the area including the Parish of Flixton. The B. of T. has now replied stating that the order has already been granted, and it was unable to advise the Council as to what *locus standi* it possessed to oppose the order in Parliament.

Leyton.—The accounts of the U.D.C. electric light undertaking for the year ended March last show that the revenue amounted to £20,280, and the gross profit to £10,296. After meeting capital charges and interest, the net profit amounted to £1,104.

London.—L.C.C.—The question of loans was again raised at Tuesday's meeting of the Council. In the first place, the Finance Committee reported that the Camberwell B.C. had applied for a loan of £500 for the provision of a gas engine and dynamo at the Public Baths, and it recommended that the request should be granted. A discussion tended to show that energy should be purchased from a supply company, but the proposal was agreed to. It was also resolved to lend £2,635 to the Bermondsey B.C. for installing condensing plant at the generating station.

The Finance Committee recommended the Council to advance £5,786 to the Poplar B.C. for machinery and works in connection with the electricity undertaking, repayment to be within 42 years. Sir Melville Beachcroft asked whether it was right to sanction loans for 42 years for extensions, or whether the fresh loans should not date from the period of raising the original loans. In reply, Lord Welby stated that the usual practice was followed. The recommendation was adopted, and it was also decided to lend £10,500 to the Stepney B.C. for extending the mains.

The Highways Committee, in the course of a report on the Greenwich generating station and the Royal Observatory, stated that the work of erecting the former was well advanced by the end of 1903, and the first two chimneys were almost completed. Although the position of the chimneys is one of the principal dangers urged, it was not until almost two years afterwards that the attention of the Council was drawn to the matter by the Observatory authorities. Down to the present there had been no serious interference with the observations at the Observatory, and it was believed that any of the difficulties anticipated could be prevented or remedied with the assistance, if necessary, of advice from experts. However, pending further inquiry, orders had been given for the building of the new chimneys to be suspended for the present. In a further report the Committee remarked that the Lords of the Admiralty had suggested that a series of tests extending over a considerable period should be carried out in order to arrive at a fair estimate of the amount of interference. With this object the Admiralty proposed that a small Committee, consisting of representatives of the Admiralty and of the Council, should be formed to conduct the investigation. The proposal was acceptable, and the Committee were authorised to take the necessary steps for co-operating in the matter.

Marylebone.—The sum of £350 per annum is to be debited in future against the electricity undertaking in respect to central establishment expenses. The Finance Committee reported on Tuesday the receipt of a letter from the L.C.C., stating with respect to the application to borrow £136,162 for electric lighting purposes, that it was prepared to advance £60,000 on account of new work as under:—New machinery and mains, £45,600 (repayable in 42 years); meters and house services, £14,400 (repayable in 10 years). The Finance Committee of the L.C.C. suggested that the Council should not press for the first payment of principal to be postponed for three years from the date of borrowing, seeing that the Council's undertaking is now in working order, and that the new works are for the most part of such a kind as will speedily become revenue-producing. A memorandum was considered from the Electric Supply Committee of the B.C. pointing out that the L.C.C. in the foregoing proposed two departures; first, the alteration of the practice of allowing the three years' postponement of repayment; and secondly, making the house services loan repayable in 10 years. The Finance Committee of the B.C. intimated that it had decided to take up the loan of £60,000, but will ask the L.C.C. to extend the time for the repayment of that part of the loan (about £7,000) required for house services from 10 years to 42 years.

St. Pancras.—The statement of the accounts of the electricity undertaking for the year ended March 31st, was circulated on Monday. The expenditure on capital account during the 12 months was £17,879 (principally on extension of mains), bringing the total capital expenditure up to £498,296; of this £54,802 has been repaid. The gross income for the year amounted to £72,086, an increase of £3,627 upon the previous year, and after meeting all working expenses and the repayment of loans and interest charges, there was left a net profit of £9,441, as compared with £13,098 in the previous year. The latter period included nine months before the charges for energy were reduced. The increased income is derived as follows:—£1,605 for private lighting, £1,460 for public lighting, and £561 for sundry chargeable works. The reserve fund commenced the year with a balance in hand of £30,226, and with the sum of £10,000 added from previous profits and a sum for interest on investment of £665, there had been a total credit in the fund of £40,891. Against this credit and in accordance with the L.C.C.'s sanction of electricity loans, there had been charged the net cost of replacement of plant during the year at King's Road station amounting to £6,897. There had also been charged against the fund the cost of opposition to Electrical Bills in Parliament amounting to £2,480, and other sums for law and Parliamentary costs, altogether a total of £9,783. The Committee has provisionally decided that the net profit shall be disposed of by placing £5,000 to the relief of the rates and retaining the balance in the electricity net revenue account to form a nucleus of a working balance for electricity purposes.

Steps are to be taken for commencing the works in connection with the instalment of electric light in the workhouse at an estimated cost of £500.

Grimsby.—The Corporation has given notice to the R.D.C. of its intention to apply during the next session of Parliament for an E.L. prov. order for the parishes of Little Coates, Great Coates, Stallingborough, Habrough, Immingham, Healing, Aylesby, Bradley, Laceby, Waltham and Scartho.

Hull.—The Corporation E.L. Committee has decided to reduce the price of energy for lighting from 4½d. to 4d. per unit.

Japan.—Osaka.—As an instance of the rapid progress of the electrical industry in Japan, especially in the field of illumination, says the *Anglo-Japanese Gazette*, we may mention that the Osaka Electric Light Co. has now in full working order four separate generating stations. The plant of these stations includes single-phase, two-phase and three-phase equipment, besides a number of monocyclic machines. For driving the older plant, reciprocating engines are used, but in the case of all the more recently installed plant, turbo-generators of the Curtis type are employed. There are two of these, with a capacity of 500 kw. two-phase, two of 500 kw. three-phase, and one of 1,000 kw. two-phase, all for 2,300 volts. In addition to these are two 600-kw. two-phase alternators driven by cross-compound horizontal engines. Both steam-driven and induction motor-driven exciters are employed. A fifth station is being constructed, for which two 1,000-kw. turbine sets are being built. The energy from each of the stations is used principally for illuminating purposes. At present there are 85,000 lamps in circuit, 90 per cent. of the energy being sold under the contract system and not by meter. All wires are laid underground. Government supervision of all electrical work tends to ensure a high standard in all Japanese electrical enterprises. Government control also regulates the use of earthed circuits. These regulations require a complete insulated circuit on trolley lines within the city boundary. This means that all cars have a double trolley line and no earth return.

Hydro-Electrical Development.—A notable development is taking place in the utilisation of water for power purposes and the generation of electricity in the neighbourhood of Kobe. Of new companies the Uji River Electric Power Co., has a capital of 20,000,000 yen and a plant capable of developing some 40,000 h.p. This concern will supply energy to Kyoto and the surrounding district for lighting and power purposes. A further company will shortly start work for supplying Nagoya firms with electricity in bulk, including the Nagoya Electric Light Co, Nagoya Electric Tramway Co., the Arsenal and the Miye Spinning Co. The Hanshin Electric Railway Co. is also considering a scheme for the construction of a generating station, the plant to be driven by water-power.

Kettering.—From the commencement of next quarter the U.D.C. has revised its scale of charges for energy for power as follows:—

For the first 500 units used per quarter, 2d. per unit.

Above	500	and up to	2,000	per quarter,	1½d. per unit throughout.
,,	2,000	,,	3,000	,,	$1\frac{7}{8}$d. ,,
,,	3,000	,,	4,000	,,	1¾d. ,,
,,	4,000	,,	5,000	,,	$1\frac{5}{8}$d. ,,
,,	5,000	,,	6,000	,,	1½d. ,,
,,	6,000	,,	7,000	,,	$1\frac{3}{8}$d. ,,
,,	7,000	,,	8,000	,,	1¼d. ,,
,,	8,000	,,	9,000	,,	$1\frac{1}{8}$d. ,,

When the total number of units per quarter exceeds 9,000 a uniform rate of 1d. throughout.

Kingsbury.—The U.D.C. has sealed the transfer of its E.L. order to the North Metropolitan Electric Power Supply Co.

Loughborough.—Acting on the recommendation of the borough electrical engineer, the Electricity Committee has decided, subject to the sanction of the T.C., to supply energy for power purposes during the six summer months at a flat rate of 1d. per unit during the 24 hours, and at the same rate during the six winter months, provided that consumers using energy for motive purposes will undertake to electrically light all parts of their premises in which there is machinery driven by electricity. The price of energy for lighting purposes is to be 3d. per unit, if the consumer provides his own wiring, and 4d. per unit if the wiring is installed on the free-wiring system. The prices are to come into force as from July 1st, 1906.

Luton.—A loan of £7,000 for cable extensions has been applied for by the T.C.

Mountain Ash.—Mr. Day, the Council's expert, has recommended the U.D.C. to carry out an E.L. scheme for supplying energy to Mountain Ash, Penrhiwceiber, Abercynon and Ynysybwl.

Mining.—The Fine Cotton Spinners' Association is putting down an electrical installation for lighting and other purposes at its new coal mine which has been sunk in Forge Lane, Bradford, near Manchester. The shaft is over ½ mile deep, and the sinking has occupied about three years. The Association owns other collieries close by, which supply its extensive cotton mills with fuel.

Newark.—The U.D.C. has decided to ask the National Electric Construction Co., Edmundson's Electricity Corporation, and the Derby and Notts Electric Supply Co., Ltd., to enter into negotiations for the supply of electricity.

Oldham.—The Oldham Corporation Electricity Committee on Wednesday adopted a revised scale of charges for energy for power purposes on a time-switch system from 6 p.m. to 10 p m. as follows:—1½d. per unit up to 2½ h.p., 1¼d. up to 5 h.p., and 1d. over 5 h.p. The former charge was 2d. and 1½d. per unit, two-hour maximum demand.

Railway Carriage Lighting.—In his annual report for 1905, the Chief Locomotive Superintendent of the C.S.A.R. records that the acetylene gas plant, which was loaned during the year, and which was erected in the Pretoria shops, was used, and several competitive tests of acetylene and electrically-lighted coaches made. The result of the trials showed that the cost per candle-power of the two systems was practically the same, but that in the acetylene gas system there were disadvantages, namely: Less convenience, danger from explosions, and necessity for withdrawal from traffic whilst charging. It was decided during the year that the electrical system was the best for South African railways. — *Commercial Intelligence.*

Sheffield.—An exhibition of electrical appliances, &c., is to be held at the Corn Exchange from September 27th to October 20th, under the auspices of the Corporation Electricity Department. Those desiring to exhibit should apply to Mr. S. E. Fedden, engineer and manager.

South Africa.—The Rand.—A note is going the rounds of the daily Press to the effect that a great electrical undertaking to supply the South African mines with electrical energy, is proposed, in which undertaking the A.E.G. is said to play a prominent part. A sum of 120,000,000 marks is required to capitalise the scheme, which will be put up for subscription by the A.E.G. and a number of English houses with which, it is understood, the Chartered Co. is associated.

Stoke-on-Trent.—The T.C. has decided to send the statutory notice to Fenton U.D.C. of its intention to apply for a prov. order enabling it to supply electricity within the Fenton area.

A loan of £1,998 for the provision of further steam plant at the electricity works has been applied for.

The L.G.B. has sanctioned a loan of £7,249 for extensions at the electricity works.

U.S.A.—The twenty-ninth convention of the National Electric Light Association, held this year at Atlantic City, N.J., was opened by the Mayor last week.

Uxbridge.—The Uxbridge Electric Supply Co. has notified the R.D.C. of its intention to extend its mains from Cowley through Yiewsley.

Walthamstow.—On Wednesday the Special Committee which was appointed to consider the district auditor's report on the annual accounts of the Urban District Council issued its report. The auditor stated, *inter alia*, "A gross profit was shown on the electric lighting undertaking for the twelve months ending March 31st, 1905, of £10,183 9s. 5d., and after meeting interest and installment of loans a net profit is shown by your books. It may be questioned, however, for the following reasons, whether this undertaking was in fact run at a profit. I find that although the Council were actually in funds on their light railways capital account from the commencement of the year till June 24th, 1904, yet £20,000 was taken off light railways deposit account on June 3rd ostensibly for the light railways capital purposes, but, in fact, because the balance standing to your credit on general loan account had almost reached vanishing point. By the middle of June you had a considerable overdraft on the general loan account, chiefly occasioned by heavy overdrafts on your various electric lighting capital accounts. A further sum of £20,000 was taken off light railways deposit account on July 26th, although a few hundred pounds would have met the capital requirements of the light railways undertaking up to September 23rd. In this way constant recourse was had to light railways moneys, until March 31st, 1905, the balance shown in hand on light railways capital account amounted to £30,971 18s., but at this date you had overdrafts on eight out of nine open electric light capital accounts, amounting to

£48,432 14s. 10d., and one credit balance of £298 15s. It is perfectly fair to say that over £30,000 was due on March 31st, 1905, to the light railways capital account by the electric lighting capital account; that very considerable sums of money have been lent in this way by one fund to the other for long periods; that the borrowing fund has had the use of the money without interest and without making provision for redemption, and that consequently the profits, as shown by your books as having been earned on the electric lighting undertaking, are fictitious. Only £100 a year is debited to the electric lighting revenue account in respect of officers' salaries and expenses, a sum which would appear to be most inadequate. The actual amount of interest paid during the year is debited to the net revenue account, and not the amount accrued. The profits are also swollen to a small extent in another way. You obtained a loan under sanction of the Local Government Board for the purpose of free wiring. Part of the loan was expended on wiring premises, the cost of which was to be repaid on the hire-purchase system. The loan was to be repaid in 10 years, the cost of wiring to be recovered by the Council in five years, with interest on the sums outstanding. It appears to me to be clear that the sums received in respect of the cost of wiring are in the nature of capital moneys, and should not have been carried to revenue account. A number of agreements with reference to the hire-purchase of electric fittings were not produced at audit. Various ratepayers attended the audit, and represented to me that the charge credited to your electric lighting undertaking, and debited to district fund account in respect of public lighting was excessive. I did not find, although the charge appears to be unusally high, that the evidence on the point was sufficiently conclusive to warrant my making any adjustment. The loan raised for the purposes of installing electric light cables, lamps, &c., for public lighting are charged to the electric lighting undertaking. This is some justification for higher charges than would otherwise be the case. The charge per unit for public lighting has been reduced from 3d. to 2d. It appears to be realised that no profit has, in fact, been earned on the undertaking, as I understand that no return of profits has been made to the Income-Tax Commissioners, or income-tax paid thereon." The reply of the Committee to the foregoing was as follows:—"The whole question of the electric lighting accounts is under the consideration of the Council. In future £200 per annum will be debited to the electric lighting revenue account, in respect of the Town Hall officers' salaries and expenses." The question of supplying additional plant at the generating station is under consideration.

Wimbledon.—After October 1st no charge is to be made by the T.C. for the hire of meters to consumers whose accounts amount to 5s. and upwards per quarter.

Wrexham.—The T.C. has offered to supply energy to the Great Western Railway Co. at £156 for 15,000 units per annum, and at 2½d. per unit for over 15,000 and under 20,000 units, and 2d. per unit beyond.

York.—The Electricity Committee, after considering the report recently made by Mr. Hutchinson, consulting and mechanical engineer of Hull, in reference to the electricity works, in which he commented upon the undesirability of continuing the use of water from the Foss for the boilers on account of its excessive amount of scale-forming matter, and on the recommendation of the City electrical engineer, has decided upon the provision of a water-softening and filtering apparatus at an estimated cost of £300.

TRAMWAY and RAILWAY NOTES.

Birkenhead.—The Corporation tramways made a gross profit of £21,685 7s. during the year ended March 31st last. Interest and sinking fund charges amounted to £20,587, and with a reserve of £200 on income-tax account added, left an available balance of £898 as against £1,894 in the previous year. This profit has been applied to the renewals fund, which was brought up to £11,466. The sum of £1,448 was spent on capital account during the year. The total working expenses amounted to £32,865, and the total receipts to £54,596.

Birmingham.—The Corporation is now in full possession of three tramway routes. This week the Tramways Committee has taken over the Dudley Road line to the city boundary. The Birmingham and Midland Co.'s lease of the Dudley Road route expired at midnight on Saturday. The Corporation cars were placed on the road on Sunday.

The Committee has made progress with other lines. The route from Horse Fair to a junction with the Dudley Road line is finished, and the Committee is now endeavouring to come to terms with the City of Birmingham Tramways Co. for running powers over the company's line from Horse Fair, along John Bright Street, to Navigation Street. Other outlying routes are practically finished, but none will be opened before January 1st next. Meanwhile work is being carried on in the centre of the city; lines are being laid down to form the central junctions with all the radiating lines. Martineau Street, Corporation Street and James Watt Street are in the hands of the workmen for this purpose, and as soon as the widening of Dale End permits, that thoroughfare will be taken in hand.

Continental Notes.—Italy.—The Administration Committee of Italian State Railways is considering investigations which have been made at Genoa by an expert Commission for the application of electric traction to the Giovi lines. Two projects have been prepared, the first by Ing. Martinoli, who proposes that the lines should be on the cog system (A.C.), on which small trains should be run having a speed of from 4 to 5 kilometres per hour, and running at short intervals; the second project prepared by Ing. Crosa consists of the simple substitution of electric locomotives for steam locomotives. The Communal Council of Castelgandolfo proposes to grant a concession to Ing. Monaco for the construction of a funicular railway.

A meeting has recently been held, at which it was decided to form a committee with a view to the construction of an electric tramway from Pescia to Fucecchio, Valdarno and Ponte Buggianese.

Spain.—The British Consul at Barcelona reports that nearly all the existing tramway companies of that town have made small extensions of their lines in the year 1905, but none of them have carried out any important work except the Sarria-Barcelona Railway Co., which has completed the electrification of its line, and has also built the funicular railway connecting Sarria (a suburb of Barcelona) with the mountain village of Vallvidrera. This funicular line is expected to be opened in the spring; it has led to numerous villas being built on the mountain side overlooking the city and the sea. The Barcelona Tramways Co., the most important British enterprise in the city, has sold its business to a Belgian syndicate; thus, the entire system of electric tramways in Barcelona is now in the hands of German and Belgian companies.

A concession has been granted by the Direccion General de Obras Publicas, Madrid, to the Compania Madrilena de Almacenes generales de Depositos y Transportes for the construction and exploitation of an electric tramway from the Glorieta de Atocha to the Paseo de los Pontones, Madrid.

Croydon.—The first month of the Council's working of the tramways in the borough shows an increase, averaging 20,000 each week, in the number of passengers carried over the number carried in the corresponding month of last year under the B.E.T. Co.'s management.

Derby.—A statement of the receipts and expenditure of the Corporation tramways undertaking, to be submitted to the next meeting of the Council, shows a net profit on the year of £6,529. In the previous year the net profit was £3,640, but two new routes have been opened in the meantime.

Glasgow.—Some alarm was caused in Glasgow on the 28th ult. by a car proceeding down the incline from Cowcaddens to Sauchiehall Street, running away. The car, however, was brought to a standstill without accident.

Guatemala.—The U.S. Consul at Guatemala City reports that the street railways of the city, consisting of about 10 miles of single track, with turn-outs and rolling-stock, have been taken over by a syndicate controlling the Guatemala Railway Co., which will electrify and extend it. It is intended to erect a tramway water-power plant. The company is to be reorganised as an American company.

Halifax.—On July 1st an electric car from Shelf, proceeding down a steep gradient known as New Bank, ran away and overturned on the North Bridge at the foot of the hill, two persons being killed and 12 injured. The driver of the car, who stuck to his post, has made a statement in regard to the greasy state of the track. We understand that this is the first serious accident which has occurred on the Corporation tramways since they were opened in 1898.

Leyton.—The U.D.C. has completed the purchase of the North Metropolitan Co.'s system in High Road, Leytonstone, and the work of electrification is to be proceeded with.

Liverpool.—As compared with the first half of 1905, the returns of traffic on the Corporation tramways show an increase this half-year of 1,369,482 passengers carried. The actual number for the past six months was 57,116,759. The cash receipts amounted to £263,033, an increase of £5,848.

Llandudno-Colwyn Bay.—The *Liverpool Daily Post and Mercury* says that the shareholders of the Llandudno and Colwyn Bay Electric Traction Co. have formally assented to the sale of the assets of their railway to the Carnarvonshire Electric Traction Syndicate, Ltd. It is stated that an agreement has been signed between Mr. W. Horton, of Colwyn Bay, and Messrs. Bruce Peebles & Co., under which the latter are to complete ready for traffic, the portion of the light railway between Vaughan Street, Llandudno, and the promenade at Rhos-on-Sea. The syndicate is understood to have agreed with the Llandudno and Colwyn Bay Councils that it will complete as early as possible the entire scheme, which is for a light railway from the Colwyn Bay Station to the West Shore, Llandudno.

London.—L.C.C.—According to the *Financial Times*, the Highways Committee of the L.C.C. will, on the 10th inst., present a report recommending the purchase of the undertaking of the London Southern Tramways Co. The company's lines comprise about 5¾ miles of horse tramways, and run from Vauxhall *vid* South Lambeth Road, Stockwell Road, Gresham Road and Coldharbour Lane, to Camberwell Green, and from Coldharbour Lane, *vid* Hinton Road, Milkwood Road and Norwood Road, to West

Norwood. As a result of negotiations the company has expressed its willingness to sell its undertaking to the Council. If the purchase money can be settled by agreement the amount to be paid by the Council for the undertaking is to be the valuation at the date of agreement, but if the matter has to be settled by arbitration the amount to be paid is the value of the undertaking at the date of the award or on October 1st, 1906, whichever shall be the earlier. The total expenditure involved by the acquisition and electrification of the tramways will probably be about £274,430, exclusive of the cost of street widenings, which is estimated at £63,000. This figure of £274,430 includes provision for additional capital expenditure for cars, &c., necessary to enable through-car services to be run over portions of the tramways *viâ* Vauxhall to Victoria station. As regards the financial aspects of the proposed purchase and working of the tramways generally, the Committee is of opinion that the tramways will prove to be self-supporting as soon as the electrification is completed, and there can be no question that they will add materially to the convenience of the travelling public.

Highgate and Swindon Accidents.—In the House of Commons last week Mr. Lloyd-George, President of the Board of Trade, answering Mr. Myer (Lambeth, N.) and others, said he was informed that magnetic brakes were in use on the trams which met with accidents at Swindon and Highgate. Both accidents were now the subject of inquiries by the Board of Trade, and he could not say what measures would be taken in the matter till the reports had been received.

Mr. Myer asked if, at an inquiry into a similar accident last April, expert evidence was not given that a tramcar going at the rate of 4 miles an hour could not be stopped under 45 ft.?

Mr. Lloyd-George: I am not aware of that.

Another hon. member asked if it were not a fact that magnetic brakes became inoperative when the wheels skidded?

Mr. Cairns (Newcastle-on-Tyne) inquired what compulsory stopping places there were on this steep gradient?

Mr. Shackleton (Lancashire, N.E.) suggested that the rail brake should be used on a steep incline of this nature.

Mr. Lloyd-George promised that attention should be given at the inquiry to all these points.

Over-Bridge Tramways.—Mr. S. Sellon, M.I.C.E., in giving evidence before the House of Lords Committee on the L.C.C. tramways, said that 2,260 cars arrived every day at the Blackfriars and Westminster termini, giving a yearly total of 824,900. The bridges and the embankment measured a mile and three-quarters, so that the cars, according to the scheme, would cover 1,440,000 car-miles. On this basis of calculation only £4,000 would be left out of the estimated takings after providing for maintenance and other expenses and without taking into account the interest and the sinking fund. Without allowing for depreciation, the line would involve a loss of £6,000 a year, and with depreciation of £18,000 a year.

The Light Railway Commission.—The Herts County Council has been granted an order to construct tramways in Watford and Bushey up to the Herts border at Stanmore. It is intended to link up the lines with the Edgware and Marble Arch tramways, and so give the neighbourhood direct tramway access to London.

Luton.—The T.C. has decided to apply to the B. of T. for an extension of time to August 11th, 1907, for commencing the construction of the electric tramways.

Middlesex.—At a recent meeting of the C.C., a report by a firm of chartered accountants on the method of keeping the accounts and books of the Metropolitan Electric Tramways, Ltd., as regards the lines in which the Council are interested, was submitted. Various proposals in regard to the foregoing, received from the company, were adopted, with the exception of one suggestion which was in regard to cumulative interest.

New York City Subways.—Following much public criticism, a decline in traffic, and the refusal of the Interborough Rapid Transit Co. to take steps to ventilate the subway, the municipal authorities are to install ventilating fans and a circulation cooling system at various points, at a cost of £15,000. Work on the Belmont Tunnel, to connect the Grand Central Station with Long Island by boring under the East River, is proceeding rapidly, £600,000 having already been spent on the work. The city authorities allege that the whole undertaking is being done without legal permission.

Paisley.—The extension of the Paisley District Tramway Co.'s line from Potterhill, Paisley, to Barrhead is now completed, and the B. of T. inspection was fixed for Monday last. It was expected that cars would be running on the following day. The extended line is about three miles in length.

The B. of T. inspection of the Johnston and Kilbarchan line was also expected to be made the same day.

Penge.—As a result of the Highgate tramway disaster, the Penge Council has this week discussed the necessity of taking extra precautions to avoid a similar catastrophe on the stretch of the Anerley line leading to the high level at Upper Norwood. Here the gradient is one in nine, and in reply to the questions of the Council, the surveyor stated that the company had tested the brakes at 30 miles an hour, and the car had been stopped within 30 yards.

Porto Rico.—The British Consul in Porto Rico reports that there are two electric railroads running successfully in Porto Rico, one from San Juan to Rio Piedras and another from the town of Ponce to the harbour; the latter line has recently been considerably extended, and the carriage of merchandise between the city and port of Ponce has been added to the passenger traffic.

Pudsey.—Representatives of the Bradford and Leeds Tramways Committees visited Pudsey on 27th ult. to confer with the T.C. on a proposal made by the latter body that Leeds or Bradford, or both, should run trams through the town and connect the two systems. The matter is under consideration by the respective towns, and in the meantime the Pudsey Corporation will submit to each Council a plan of its proposals.

South Lancashire Tramways.—The length of new tramway between Farnworth and Walkden was officially inspected last week by Col. von Donop, on behalf of the Board of Trade. It is understood that a regular service of cars will begin at once. By the end of August the line will be continued to Swinton and thence to Worsley and Boothstown, where a connection will be formed with the existing line to Eccles and Salford. Arrangements are also being made for connecting Kearsley with Pendlebury.

Swindon.—At the resumed inquest on the victims of the tramway disaster, Mr. Collett, assistant-manager of the Great Western Locomotive Works, who saw the car immediately after it overturned, said that from the state of the wheels it would appear that they skidded when the car tilted, just before turning over in the loop, through the magnetic brake putting the wheel brakes on tightly.

Driver Lyons, who had charge of the car, stated that various complaints were made by himself and another driver about the brakes not working properly, but nothing was done. When descending the hill his canopy switch "blew," and the hand-brake handle flew round and struck him on the body. He tried the magnetic brake, but finding the wheels skidding, he attempted to work the hand-brake, but could not move the handle. He again put on the magnetic brake, without, however, checking the speed of the car.

Wednesbury.—The General Purposes Committee of the T.C. has consented to an application from the Corporation of Walsall for permission to enter into an agreement with the South Staffordshire Tramways (Lessee) Co., for intercommunication between the Bridge at Walsall and the terminus of the company on the Wednesbury section at or near the White Horse Inn, Wednesbury, the agreement being for a period of three years certain, and thereafter subject to six months' notice on either side; but this consent is expressly given "without lessening, taking away, interfering with, or prejudically affecting the rights and powers of the Corporation of Wednesbury in regard to so much of the tramways as is situate within the borough of Wednesbury."

TELEGRAPH and TELEPHONE NOTES.

Australia.—Telephone trunk lines have been extended from Hollybush to Ballarat and Melbourne, and from Hepburn to Daylesford, Allendale, Creswick and Ballarat.

Answering a Bendigo deputation, the Commonwealth Acting-P.M.G. promised that their protest against the proposed toll charges should be fully considered.

A Brisbane paper says that it is probable that the Government will postpone the introduction of the toll telephones until January, 1907, and rescind the announcement made in February last, that the new system of charges should become operative to new consumers on 1st inst.

Belfast Telephones.—A meeting of the local branch of the Telephone Employés' Society has been held, at which a resolution was passed calling upon the head office to reinstate the local secretary by withdrawing his dismissal notice at once. If this demand is not acceded to, and other grievances remedied, a strike is threatened on July 5th. The Dublin branch is supporting the resolution.

Ceylon Telephones.—The opening of the new Cinnamon Garden exchange, which was fixed for 1st inst., has had to be postponed, owing to non-delivery of switchboard apparatus from home.

Glasgow Municipal Telephones. — The Municipal Telephone Committee has recommended that the telephone system of the Corporation be sold to the Government for £305,000, exclusive of stores and tools, on the understanding that the system be conducted as a branch of the Post Office service. The proposal will probably be opposed in Council. After allowing for sinking fund and for depreciation, this means a loss of about £15,000.

Huddersfield Telephones.—The N.T. Co. has informed the Huddersfield Chamber of Commerce that it is prepared to reconstruct its system at Huddersfield, if the Corporation will give the necessary permission.

Japanese Cable Extensions.—The Island of Hachijo lies due south of Tokio, distant about 160 miles, and during the war with Russia a cable was laid to it from Kawasaki, a point midway between Tokio and Yokohama, for military purposes. According to the *Morning Post*, this has now been extended about 430 miles to the Bonin group, one of Japan's outposts in the Pacific. The Bonins are better known to-day as the Ogasawara Isles, and number 20 in all, having a total area of 27 sq. miles.

The Japanese Government's own cable-laying steamer *Okinawa-Maru*, built at Renfrew, was entrusted with the work of laying the line from Hachijo to the Ogasawara group, she being met at that point by the Pacific cable ship, which had laid the cable northward from Guam, an island belonging to the United States, in the Ladrones, or Marianne Archipelago. From Guam another cable was recently laid to Shanghai by the Pacific Cable Co., so that from Guam submarine lines now diverge to Manila, Shanghai and Tokio.

Swansea-London.—Last week a new direct telephone line was opened between London and Swansea.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	.. Aug. 26, 1901 ..	..
Dominica-Martinique	.. May 7, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Reissa-Issa (Yemen) Camaran	.. Oct. 22, 1902 ..	..
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 7, 1904 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Landlines.		
Puerto-Barrios	.. Aug. 28, 1903 ..	..
Bachkale-Deliman	.. Feb. 12, 1906 ..	..
Trebizonde-Batoum	.. June 25, 1906 ..	..

Wireless Telegraphy.—Pressure is being brought to bear upon the U.S. Government with a view to compelling the Marconi Wireless Telegraph Co. to accept messages from ocean-going vessels when transmitted by rival companies.

CONTRACTS OPEN and CLOSED.

OPEN.

Beckenham.—July 23rd. Electric wiring of houses for the U.D.C. See "Official Notices" to-day.

Bolton.—July 12th. Condensing apparatus for the electricity department. See "Official Notices" June 29th.

Dublin.—July 9th. Sub-station switchboards and accessories; transformer pillars for the Corporation. See "Official Notices" June 29th.

Dublin.—July 9th. Certain electric works for the Board of Public Works. See "Official Notices" June 29th.

Dundee.—July 13th. The T.C. invites tenders for six electric car bodies. Specifications from Mr. Peter Fisher, general manager, Corporation tramways. (Deposit 40s.)

France.—The French Post and Telegraph authorities in Paris are inviting tenders until July 12th for the supply of 6 tons of galvanised iron wire, 1 mm. diameter; 187½ tons ditto, 3 mm. diameter; 375 tons ditto, 4 mm. diameter; 135 tons of bronze wire, 2 mm. diameter; and 20 tons ditto, 3 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Guatemala.—The City street railways are to be electrified and extended by an American company. Particulars can be obtained by inquiry to Ferro Carril Urbano de Guatemala.

Hackney.—July 26th. Arc lamps and arc lamp pillars, switch pillars, &c., for the Council. See "Official Notices" June 29th.

King's Norton and Northfield.—July 16th. Tramways permanent way and electrical equipment for the U.D.C. See "Official Notices" to-day.

Lancashire.—Condensing and water softening plant for the County Asylum, Rainhill. See "Official Notices" to-day.

Leeds.—July 16th. The Electricity Committee invites tenders for 150 tons of coal tar pitch.

L.C.C.—July 10th. High and low tension cables for the tramways. See "Official Notices" June 22nd.

Roumania.—July 10th. The municipal authorities of Focshani are inviting tenders for the concession for the electric lighting of the town.

Spain.—The municipal authorities of Becedas (province of Avila) have just invited tenders for the concession for the electric lighting of the town during a period of 10 years.

Stepney.—Tenders are to be invited during the vacation for the execution of additions and alterations at the electricity works. The tenders will be received by the Council at their first meeting in October. Tenders are also to be invited for the installation of electric lighting at two underground conveniences.

Sunderland.—July 27th. Two 250-kw. synchronous motor-generators, and high and low tension switchgear, for the Corporation. See "Official Notices" to-day.

Twickenham.—July 11th. Electric lighting installation for the U.D.C. sewage disposal and destructor works. See "Official Notices" June 22nd.

Wallasey.—July 16th. A.C. transformers for the U.D.C. See "Official Notices" June 15th.

West Ham.—July 13th. Cable and transformers for the electricity department. See "Official Notices" June 29th.

CLOSED.

Dartford.—The U.D.C. has accepted the following tenders for annual supplies to the electricity works:—

British Thomson-Houston Co.—Meters, £107 14s.
Johnson & Phillips, Ltd.—House service cable, £120 13s.
British Insulated & Helsby Cables, Ltd.—House service cut-outs, £15 17s.
F. Bird & Co.—Solder, fuse wire, files, tools, &c., £10 8s.
S. W. Gibson & Co.—Oils, jointing rings, packing, &c., £11 1s.

London.—Bermondsey.—The B.C. has received the following tenders:—

700 yards ·2 by ·2 by ·1 Triple-Concentric Cable.

W. T. Glover & Co.	(accepted)	£335
St. Helens Cable Co.		339
British Insulated and Helsby Cables		343
Johnson & Phillips		343
Siemens Bros.		346
Callender's Cable Co.		354

One Electrically-Driven Boiler Feed Pump.

Brush Electrical Engineering Co. (water meter £8 5s. extra)	(accepted)	£95
Hayward, Tyler & Co. (water meter £8 extra)		101
General Electric Co. (water meter extra)		118
Marples, Leach & Co.		126
Crompton & Co.		141
Mather & Platt		183
Alliance Electrical Co.		139

A sum of £2 10s. had to be added to the above prices for pressure gauge.

Stepney.—The B.C. has received the following tenders for annual supplies:—

Meters up to a Capacity of 10 Amperes.

Reason Manufacturing Co.	(accepted)	£262
Electrical Co.		282
British Thomson-Houston Co.		302
Chamberlain & Hookham, Ltd.		325
Ferranti, Ltd.		325

Meters Above a Capacity of 10 Amperes.

Chamberlain & Hookham, Ltd.		£303
Ferranti, Ltd.	(accepted)	303

Seven tenders were informal.

Demand Indicators.

Monte Callow & Co.		£318
Reason Manufacturing Co.	(accepted)	337

One tender was informal.

Carbons.

Sloan Electrical Co.	(accepted)	£568
Improved Electric Supplies, Ltd.		697
Siemens Bros. Dynamo Works, Ltd.		711

Eight tenders were informal.

Fulham.—The B.C. Electricity Committee, in a report circulated on Monday, stated that the electrical engineer had been in communication with the British Westinghouse Co. with regard to the price of their meters, which have proved to be the most satisfactory at present used in the borough. In consideration of the Council taking at least 300 meters during the year, the company had agreed to reduce their price for 5-ampere and 10-ampere meters from £3 15s. and £4 to £2 and £2 2s. respectively. The Committee has sanctioned the arrangement that 300 meters be obtained during the year on the foregoing terms.

St. Pancras.—The B.C. has accepted the following tenders for the annual supply of coal for the electricity department:—

Brentnall & Cleland.—Nutty slack, 10s. 3d. per ton.
Facer & Co., Ltd.—Watnall and Griff, 14s. 7d. and 14s. 9d. per ton.
J. H. Gilman & Co.—Desford, 13s. 3d. per ton.

There were 14 tenders.

Marylebone.—The B.C. has continued the existing contract with Messrs. Cory & Co. for the supply of coals (Shipley double screened nuts, at 12s. 9d. per ton) to the generating station to the end of September.

Luton.—The T.C. has accepted the tender of the St. Helens Cable Co., Warrington, for the supply of 4,814 yards single-core cable, at 15s. per yard, 55 yards single-core fireproof cable, at 16s., and 1,385 yards three-core cable, at 1s. per yard.

Middlesex.—The C.C. has agreed, subject to the approval of the B. of T. and the local authorities, to place orders for the construction of tramways as follows:—(1) Dick, Kerr & Co., railway No. 15, from the Willesden Green Metropolitan Railway Station to the "Case is Altered" P.H., at the same prices, and under the same schedule, as the firm constructed the line from the Edgware Road to the Willesden Green railway station; (2) Dick, Kerr and Co., railways 1 and 4, from the tramlines at the Hertford Road to

Enfield Town station, under the same prices and schedule as railway No. 15; (3) Wimpey & Co., railway No. 7, from the termination of railway No. 2 at Southgate to the bridge north of New Southgate station, at the same prices, and under the same schedule, as the firm is constructing railway No. 2.

Pontypridd.—The following is a list of tenders received by the D.C. for new feeder cable:—

W. T. Henley's Telegraph Works Co.	(accepted)	£2,378
Western Electric Co.		2,442
St. Helens Cable and Rubber Co.		2,478
British Insulated and Helsby Cables, Ltd.		2,488
Siemens Bros. & Co		2,494
W. T. Glover & Co.		2,503
Callender's Cable & Construction Co.		2,534

Salford.—The Corporation has decided to install a 1,000-KW. Willans-Parsons turbine coupled to direct current dynamo of Brown, Boveri manufacture. The complete order for the turbine, dynamo and condensing plant, has been placed in the hands of Willans & Robinson, Ltd., Rugby.

Stoke-on-Trent.—The T.C. has accepted the tender of the Stanton Iron Co. for the supply of steam piping for new plant at the electricity works, at £159 13s. 6d.

Swansea.—The E.L. Committee has accepted the tender of the General Electric Co., Ltd., for a 600-KW. continuous current steam generator, condensing plant, piping, &c., at £6,106. The engine will be by Maclaren.

Wimbledon.—The T.C. has accepted the following tenders in connection with the electricity undertaking:—

Foster & Co.—12 Union "Excello" arc lamps, £113 15s.
Lucy & Co.—12 lamp columns, £84.

Wrexham.—The T.C. has accepted the tender of the Triplex Electric Engineering Co., Wrexham, for the installation of the E.L. at the Free Library, at £78 10s.

FORTHCOMING EVENTS.

To-day's Events (Friday, July 6th).—At 7 p.m. Finsbury Technical College Old Students' Association. Finsbury Technical College, E.C.

Friday and Saturday, July 6th and 7th.—Our Foreign Electrical Visitors at Leeds, and returning to London.

SPECIAL NOTICE.

IN consequence of the alteration in the time of dispatch of the early morning newspaper trains, we shall in future have to go to press with the ELECTRICAL REVIEW somewhat earlier than has been our custom. Our contributors and correspondents everywhere are asked to bear this in mind, as by dispatching their communications to us earlier in the week, they can materially aid us in our work.

We wish specially to point out that in future letters intended for our "Correspondence" columns *must be in our hands by 5 o'clock p.m. on Tuesday.* Otherwise they will be held over for the following week's issue.

Our Advertisement Department also asks all concerned to kindly note that in future "Official Notices" and small prepaid advertisements should be delivered here not later than 9.30 o'clock a.m. on Thursday, instead of noon as hitherto.

NOTES.

Sir John Brunner and the National Physical Laboratory.—After the ceremony on Monday last week, when Mr. Haldane opened the electrical laboratory of the National Physical Laboratory, Sir John Brunner most generously placed the sum of £5,000 at the disposal of the Committee towards the completion and equipment of the additional buildings for engineering, metrology and metallurgy, now in course of erection.

Poles for H.T. Transmission Lines.—In our issue of June last a detailed description of the overhead transmissions employed by the Lancashire Power Co. appeared. We ought to have stated that these poles, complete with cross-arms, ironwork, &c., but without insulators, were supplied by Messrs. Richard Wade, Sons and Co., Ltd., of Hull.

History Repeats Itself.—The mantle of the prophet Welsbach has apparently fallen on Sir William Preece, for according to the daily papers, Sir William has been strongly urging the trustees of Carnarvon Harbour to light their promenade by incandescent gas. He is further credited with saying that he always recommends public authorities to use incandescent gas in preference to electricity for street lighting. We were under the impression that he had been responsible for more than one scheme of electrical street lighting, and this does not seem improbable in his capacity as a consulting electrical engineer. But perhaps Sir William is a practical joker?

The B.A. Meeting at York.—Among the papers expected to be read before the Engineering Section (G) at the meeting of the British Association next month are the following:—

Presidential Address by J. A. Ewing, D.Sc., F.R.S., President of the Section.
H. C. H. Carpenter—"Structural Changes in Nickel Wire at High Temperatures."
Sir John Wolfe Barry, K.C.B., F.R.S.—"Standardisation in British Engineering Practice."
J. B. Henderson—"Recent Advances in our Knowledge of Radiation Phenomena, and their Bearing on the Optical Measurement of Temperature."
S. H. Davies and F. G. Fryer—"The Removal of Dust and Smoke from Chimney Gases."
Sir W. H. Preece, K.C.B., F.R.S.—"Glow Lamps Up-to-date, and the Grading of Voltages."
C. F. Jenkin—"The Advent of Single-Phase Electric Traction on Railways."
G. Gerald Stoney—"Some Recent Developments of the Steam Turbine."
Prof. W. E. Dalby—"Some Recent Experimental Results with Internal Combustion Engines."
A. J. Martin—"A General Supply of Gas for Heat, Light and Power Purposes."
Prof. W. E. Dalby—"Experiments Illustrating the Balancing of Engines."
Prof. B. Hopkinson—"An Indicator for High Speed Engines."
Prof. B. Hopkinson and L. G. P. Thring—"A New Form of Transmission Dynamometer."
Prof. T. Hudson Beare—"The New Engineering Laboratories, Edinburgh University, and their Equipment."
Douglas Mackenzie—"Waterproof Roads as a Solution of the Dust Problem."
Prof. Ashcroft—"The Central Technical College Lecture Table Testing Machine."
C. E. Ashford—"The Teaching of Mechanics by Experiment (with illustrations)."

"As it Was in the Beginning," &c.—In Messrs. Hodgson's & Co.'s list of book sales last Wednesday, we noticed the following:—

Britannia Languens: Or a Discourse of Trade (containing "Instances of the Decay of our Exportations," "Excesses in our Foreign Importations," &c.). By Philangus. *Old calf.* 1680.

Cricket.—The annual cricket match between the Bexhill Corporation electricity works staff and the Town Hall staff, took place on Thursday last week. The former, of course, won by eight wickets, thanks to the excellent batting of Mr. W. T. Le Feuvre, the "chief" of the electricity department. Luncheon (about 41 present), and a smoking concert, followed.

Royal Naval Volunteer Reserve (London Division).—We have received a communication from the commanding officer of the above force, pointing out the advantages which are offered to members of the electrical trades in joining same. Apart from the interesting nature of the instruction imparted to ordinary members, men possessing the qualifications of, say, electrical engineer apprentices, switchboard, dynamo and motor attendants, men acquainted with the use of searchlights and arc lamps generally, would find their spare time very pleasantly and profitably spent by becoming members. It appears that the Admiralty offers special facilities for the men to go afloat for a period of 14 and 28 days every year in the ships of the Reserve squadrons, during which time they receive the full pay of seaman ratings of the Royal Navy; and the specialists mentioned above can draw as much as 38s. per week while serving in their capacity as tradesmen on board. The headquarters are situated at Prince's Wharf, Commercial Road, Lambeth, where full particulars of the duties, &c., can be obtained on personal or written application.

Our Canals.—It is proposed to hold a conference of Chamber of Commerce delegates at Birmingham on July 5th, to discuss the question of improving and extending our canal system.

Society of Arts Conversazione.—The Council of the Society of Arts held a conversazione in the gardens of the Royal Botanic Society, Regent's Park, on Tuesday last, July 3rd. There was a large attendance, the weather being specially favourable for outdoor enjoyment. The programme included music by the bands of the Royal Artillery and Scots Guards, a concert, a rose show, and scenes from pastoral plays performed in the gardens by Mr. Patrick Kirwan's Idyllic Players. The conservatory and the tropical house, with its Victoria Regia water lily, were open for inspection, and the grounds were effectively illuminated with Japanese lanterns and Vauxhall lamps.

A New Manufacturers' Association.—We have received a circular making a preliminary announcement concerning a new Manufacturers' Association of Great Britain, which is being established. The aim of the organisation is to be representative of manufacturing interests and to "represent to the Government and the country the principles, aims and needs of manufacturers"; to bring about closer relations between employers and employés; to deal with matters of legislation, taxation, rates, &c.; to deal with matters of international interest, such as tariffs, trusts, &c.; and some other matters. Among the members of the Provisional Committee are, from electrical and kindred firms, Messrs. G. Byng, H. Hirst, E. Manville, W. C. Mountain, R. K. Morcom, and Sir Joseph Lawrence. Mr. G. Byng is also hon. treasurer. Mr. Ben H. Morgan is secretary, and the offices are at Queen Anne's Chambers, Westminster, S.W.

Institution and Lecture Notes.—THE ASSOCIATION OF ENGINEERS-IN-CHARGE.—Last Saturday the members of this Association held their annual picnic at Box Hill, and a very representative assembly attended. The party was entertained at the Burford Bridge Hotel, and a most enjoyable day was spent. Various drives and rambles were arranged.

INSTITUTION OF CIVIL ENGINEERS.—The conversazione of the Institution of Civil Engineers was held as usual in the form of a double event, namely, on Wednesday and Thursday, June 26th and 27th, at the rooms of the Institution, 25, Great George Street, Westminster. Needless to say, the house was crowded, and many notable people were present, including Lord Kelvin, Sir Wm. H. White, Sir Jno. Wolfe-Barry, Mr. Ferranti, Sir A. B. W. Kennedy, and others. There was not this year the customary show of apparatus and models, but a lady lectured on some lantern slides of railway work in Assam to such good purpose that we could not get within earshot, and the small room with a cabin on the self-levelling principle was also too occupied for close inspection. For the rest, there was a band on the ground floor, pictures on the staircase and in the rooms, refreshments quite accessible in several places, and interesting company everywhere.

THE JUNIOR INSTITUTION OF ENGINEERS.—For the Summer Meeting of this Institution this year, Manchester and district, with headquarters at Southport, has been selected. On Saturday, July 14th, the members will be received at the Town Hall, Southport, by the ex-Mayor, Mr. Councillor Trounson, and will inspect the Corporation's gas and electricity estates and tramway depôt. The Lord Mayor of Manchester will welcome them at the Town Hall, Manchester, on the following Monday, and visits will be paid to the Municipal School of Technology, the works of the British Westinghouse Electric and Manufacturing Co., and the calico printing works of Messrs. S. Schwabe & Co. An excursion to Sarisbrick for a visit to the Hall takes place on Tuesday, and on Wednesday the National Gas Engine Works at Ashton-under-Lyne are to be inspected in the morning, and the Tudor Mill and Atlas Mill in the afternoon. Thursday will be devoted to places of local interest at Southport, and Friday the members visit Wigan for an inspection of a colliery, and a cloth weaving factory. In the evening the Institution's Summer Dinner takes place at the Queen's Hotel, Southport.

P. & O. BATTI-WALLAHS' SOCIETY.—A very successful and enjoyable summer outing of the P. & O. Batti-Wallahs' Society, in the form of a garden party, took place at Hampton Wick on Saturday last, at the invitation of the president, Mr. L. M. Waterhouse, a large gathering of the members and their lady friends being present. The weather was everything to be desired, and the river was well patronised. Two motor-boats and other river craft were provided for the use of the guests, the president's new motor-boat cruiser, *The Lady Kate*, being very much in favour, and numerous trips up and down the river were indulged in. Music, croquet and other games were enjoyed. Arrangements were discussed for a smoking concert later on in the year; practically all the members present expressed hopes of being able to attend. As there are still a large number of old P. & O. electricians (Batti-Wallahs) who have not yet joined the society, the secretary will be pleased to hear from them at 20, Bucklersbury, E.C.

Neale v. Electric & Ordnance Accessories Co., Ltd.—This case came before the Court of Appeal, composed of the Master of the Rolls and Lord Justice Cozens-Hardy, on Tuesday, on the application of the defendants for security for costs of the plaintiff's appeal.

The action was brought by the plaintiff, an infant, suing through his father for personal injuries sustained by him while in defendants' employ, which resulted in the plaintiff losing his arm. The trial took place at Birmingham before Mr. Justice Ridley and a jury, and ended in verdict and judgment for the defendants, and plaintiff had served notice of appeal.

In the result, their Lordships directed that £20 security should be given.

Fatality.—On 29th ult. a man named Thomas Chatwin met his death at the Birmingham Corporation electric supply station. His body was found buried beneath 30 tons of coal. It is presumed that he lost his balance and fell down the shoot.

For Belgian Electrical Students.—The *Standard* records that Mr. Georges Montefiore-Levi, of 35, Rue de la Science, Brussels, formerly a member of the Belgian Senate, and President of the Association of Engineers, widely known for his munificent charities in the foundation and endowment of the Liège Electrical Institute, a native of Streatham, London, who died on April 24th last, in Brussels, aged 74 years, left a sum of £12,000 to the Association of Electrical Engineers of the E.T.M. Institute, to be invested in Belgian Rentes, and applied as to :—

"One-half for the award of a prize every three years for the best original work presented relating to scientific advancement and to progress in the technical application of electricity, in all its branches, to the exclusion of works of vulgarisation or of mere compilation during the triennial period; all such works presented to be written or printed in French or English. The prize to be awarded by a jury of ten electrical engineers, of whom five are to be Belgian and five foreign.

"One-half for the creation each year of bursaries of 150 fr. each to assist the scientific excursions of students of the supplementary year, to be awarded to such students as shall apply for them in order of merit provided that they shall have received not less than two-thirds of full marks in both practical and *viva voce* examinations of the year, and the balance to be applied for travelling scholarships for the Montefiore Institution."

Appointments Vacant.—Commercial assistant for Battersea electricity department (£2 + commission); shift engineer for Battersea (£104); an assistant telegraph superintendent is wanted by the Bombay, Baroda and Central India Railway Co.; a principal electrical assistant is wanted in the L.C.C. engineer's department (£500); charge engineer for Ilford electricity works (45s.).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—On Thursday, June 28th, at the Smethwick Power Station, and in the presence of the staff and workmen, Mr. J. T. H. LEGGE, the chief assistant electrical engineer of the Birmingham and Midland Tramways, Ltd., was made the recipient of a silver salver and a mounted pipe, on the occasion of his marriage. The resident engineer (Mr. S. A. Mahood), made the presentation.

Mr. A. P. MACALISTER, chief assistant, was, at the expiration of his term as acting chief engineer at Battersea Electricity Works, presented on Saturday last with a framed illuminated address by the members of the staff as a token of their esteem and appreciation. Mr. MacAlister has occupied the post during the past four months. The address was designed and executed by the draughtsman, Mr W. H. Healy.

Mr. WOODMAN, electrical engineer to the Dover T.C., has had his salary increased by £50 per annum on his additional appointment as advisory engineer in connection with the tramways.

Mr. P. P. WHEELWRIGHT, the Blackburn borough electrical engineer, was married on June 28th to Miss Coe, eldest daughter of the Rev. Gordon Coe, vicar of St. Matthew's, Blackburn.

Mr. A. E. WILKINS, resident electrical engineer, Chepstow Electric Light and Power Co., has been appointed borough electrical engineer under the Corporation of Monmouth. He leaves Chepstow early in August.

Mr. WILLIAM H. TAYLOR, charge engineer at the Ilford electricity works, has been appointed station superintendent at Walthamstow. The Walthamstow U.D.C. has also made the following appointments at the generating station:—Mr. MILLS, of Manchester, to be works foreman, at £2 15s. per week; Mr. NOTLEY to be mains inspector, at £3 a week.

Mr. H. L. PERCY has resigned his post as deputy borough electrical and tramways engineer at Chesterfield to take up an appointment as assistant engineer with the Colombo Electric Tramways and Lighting Co. Mr. Percy sails from London on the 20th inst.

The Govan T.C. have increased the salary of Mr. W. A. Legge, chief assistant engineer, by £20 per annum.

Mr. J. ALLWARD, senior shift engineer to the Islington electrical undertaking, was appointed in November last station superintendent on probation for six months, at a salary of £180 per annum. His appointment is now to be made permanent, and his salary to be raised to £200 per annum.

One hundred and fifty-five applications were received for the recently-advertised position of mains superintendent and general engineering assistant at Ipswich. Mr. T. R. EDGE, mains superintendent at Doncaster, has been appointed.

On 3rd inst. Mr. H. RICHARDSON, the city electrical and tramways engineer, Dundee, was married to Miss Mary Elizabeth Thomson, daughter of Col. William Gordon Thomson, Taychreggan, West Ferry. Amongst the presents was a case of knives, along with a gold bangle for the bride, from the employés of the Electricity Department.

General.—Mr. H. W. TURNER, after having completed a two years' engagement at the works of the British Westinghouse Co. as engineer in charge of the winding and insulation division of the electrical engineering department, and also as superintendent of the winding and insulation department in the works, has associated himself with Mr. H. M. Hobart, consulting engineer of Oswaldestre House, Norfolk Street, Strand, and will be engaged in advising with regard to manufacturing methods, machinery and shop organisation, not only as regards winding and insulation, but also as regards other departments of works manufacturing dynamo electrical machinery. Mr. Turner, in the course of an experience of over 20 years in responsible positions in British, Continental and American works (British Thomson-Houston and British Westinghouse Co.'s 3½ years, Union Elektricitäts Gesellschaft, Berlin, and Vienna, 11 years, Thomson-Houston Electric Co., of U.S.A., nine years), has diagnosed, reported and advised in hundreds of questions arising not only in the manufacture, but also in the subsequent outside use of dynamo electrical machinery, and he now proposes to independently advise clients (both manufacturers and buyers) in these and related matters. We are asked to state that this arrangement will not interfere with Mr. Hobart's regular consulting practice, or with the giving of specialised advice on the design and standardisation of dynamo-electric machinery of all classes.

Mr. HARRY W. LAING, manager and secretary of the Cambridge Motor Omnibus Co., Ltd., has been appointed manager to the Blackpool, St. Annes and Lytham Tramways Co., Ltd. Prior to holding the Cambridge position Mr. Laing was traffic manager of Paisley District Tramways Co.

The Council of the Institution of Mechanical Engineers have appointed their President, Mr. EDWARD P. MARTIN, as one of the representatives of that Institution upon the Main Committee of the Engineering Standards Committee in place of Mr. E. WINDSOR

Richards, Past-President of the Institution of Mechanical Engineers, who has retired.

The Swedish Administration officially notify the appointment of Mr. S. A. A. Lindman, who has been directing the Telegraph Department, to the Ministry. Mr. Sven Ludvig Herman Rydin has been again nominated to undertake the work relinquished by Mr. Lindman.

The Governing Body of Battersea Polytechnic have appointed to the position of Head of the Department of Electrical Engineering Mr. A. W. Ashton, M.Sc., of the University of Leeds. Mr. Ashton is a Whitworth Exhibitioner, an 1851 Exhibition Scholar, and he obtained his B.Sc. in Electrical Engineering with honours at the Durham College of Science in 1898, afterwards graduating M.Sc. During the college vacations he worked in different departments of Messrs. Siemens & Co., of Charlton, and prior to his appointment at Leeds was for five years assistant to the manager of the Helsby Cable Co. at Runcorn, where he also conducted evening classes in electrical and other engineering subjects.

Obituary.—We regret to record the death of Mr. Louis Cassier (of *Cassier's Magazine*), which occurred in the terrible railway disaster at Salisbury on Sunday morning.

CITY NOTES.

British Electric Traction Co.

The tenth ordinary general meeting of this company was held on Friday last week at Winchester House, Old Broad Street, Sir Charles Rivers Wilson presiding.

In moving the adoption of the report and accounts, the Chairman referred to the decline in the dividend. There had, he said, been a reduction in the profits amounting to £38,063, and there were three causes which had led to that result. In the first place, their earnings were in excess of those of last year, but they had written off a much larger amount for depreciation this year—£35,000 as against £11,500. Then they had brought forward into the year's accounts only £14,996, as compared with £33,148 in the previous year, and they had also had to meet prior charges to the amount of £17,411. These were in respect of additional capital raised in the shape of debentures and preference shares. The amount thus accounted for represented a 3 per cent. dividend. There was one item about which there appeared to be some misapprehension. It was an item of the management and general expenses, and appeared on the debit side of the profit and loss account to the amount of £3,593. The total management and general expenses amounted to £54,467, which was reduced by £50,874. Of this £8,440 had been recovered from other companies, and £38,542 had already been debited to profit and loss account. What it really meant was that by following a different method of book-keeping they might have made the management expenses appear at £38,542 more, though in that case some of the profits would have appeared as £38,343 larger. Really it made no difference to the net result. One of the most interesting points was the steady reduction in expenses. In 1903 they amounted to £82,095, or 25 per cent. of the gross profits; in 1904 they were £61,436, or 20 per cent. of the profits, while for the past year they were £54,467, or 17·2 per cent. of the gross profits. The company had not been doing so much pioneer work, and would not be doing so much for a time. There was an interesting figure on the credit side of the profit and loss account, and that was the profit on the Bombay undertaking. In conjunction with the Brush Co. they had for some years been negotiating for the concessions and contracts for that important undertaking. Very heavy responsibilities had been involved, and it was at one time felt that the enterprise might not be successfully established. The difficulties had been overcome, and they now had a company with a capital of close on a million and a half to carry on the work of reconstructing the lines for electric traction, &c., and also for the purpose of supplying Bombay with light and power. They have now recovered the whole of their expenses and had made a substantial profit amounting to £154,344, which was taken in shares. They had thought it prudent to hold one half of these profits in reserve to be dealt with as assets credited to the amount of the current year. They regarded the shares thus acquired as very valuable, because the Bombay Co. possessed a long tenure of its concession. During the last two years they had felt it to be their duty to largely reduce their capital commitments, and they had given up a certain number of large schemes to which they were not already committed. The result was that their promotion profits were less, but their financial position was stronger, and they would take advantage of opportunities to procure lucrative business in the near future. They were at present earning sufficient to pay the debenture interest and the dividend on the preference shares out of their staple profits. The debenture interest and the preference dividend took up £92,000 and £970,00 respectively. They received in dividends from investments £143,600, and interest earned £21,800, while in profits earned in working directly they took £9,000, making altogether a total of £174,400. The dividend on the ordinary shares was, therefore, in the main dependent on the increasing yield on their investments, supplemented by their promotion profits. Their investments amounted to £3,105,846, producing a return of £143,652, an average of 4⅝ per cent. There was a reduction in the yield as compared with last year, but until this year there had been a steady increase. The investments had also been increased. These, sold at a profit, represented a cost of £339,105, and earned in 1904-5 £16,531. They had lost during the past year £14,903 in revenue, owing to their parting with investments that were revenue earning. Those at Poole and Yarmouth they could not help, but the one at Durham they parted with so as to limit their commitments. A larger number of their investments—£1,438,000—had not earned any revenue. The total investments amounted to £4,500,000, and over 3 millions of them were earning on an average 4⅝ per cent. As long as they were creating new undertakings, they must have some investments which were for a time unproductive. The improved position of the Brush Co. was an illustration that many of them would do well in the future. It was impossible for them to make a valuation of their assets, as many of their investments were not quoted. A large undertaking like theirs depended upon a large number of small items. An increased revenue of even ½d. per car-mile, meant an increased profit of £70,000. The associated companies worked more than 15 per cent. of all the tramways and light railways in the United Kingdom, but their expenditure was only about £12,000 per route mile, as compared with £18,800 for all the other companies' lines. Their lines were of inter-urban character, and although they worked 15 per cent. of the mileage, they only got about 11 per cent. of the total passengers, or only 668,000 per route-mile, compared with 977,000, but their working expenses were only £2,400 per route-mile, whereas the energy cost was £3,100. Considering the high rate of wages they paid, the fares charged were extremely low, and the local authorities had set examples which were very hard to compete with. They raised wages very liberally, and lowered fares without much consideration. Looking back on their ten years' working, he felt surprised at what they had done. He did not think motor-'buses would supersede well-established electric tramways, although they might the horse omnibuses. They had, in conjunction with the Brush Co., organised a department for the manufacture of motor-'buses, so they could not regard them as a competitor.

Mr. E. Garcke seconded the motion.

Mr. Tuckett said he did not think the 3 per cent. dividend had been earned, and moved as an amendment that the report and accounts be adopted, but that the dividend should not be paid. Unless they opposed the financial policy of the board nothing could prevent the company being brought to disaster. They ought not to rely on paper profits to pay cash dividends.

Mr. Croft observed that as a local authority he knew that the Brighton Corporation had refused to allow the company to have a terminus at Hove, and he thought the company ought to hold its hand.

Mr. Lea Smith said that while not agreeing with the tone of Mr. Tuckett, he thought the shareholders were equally responsible because nothing had been withheld from them, and they had approved of the policy of the directors, but he regretted at the same time that 3 per cent. was being paid. They ought to stand shoulder to shoulder with the board.

Mr. Nicholson remarked that for a company to keep on raising money at a cost of 5 per cent. and investing it in investments which did not realise immediate dividends was not sound finance.

Mr. George Herring, in supporting the board, said that no one knew better than those who were outside what policy to follow, and if the board proposed a 3 per cent. dividend and they had faith in them, there was no reason why they should not accept it.

Mr. Braithwaite justified the policy of the board, and said that if they had been able to bring out their companies in the way they expected, they would have paid their dividends. They were, as a matter of fact, in a better position that day to pay big dividends than ever they were before. Their traffic increase was £110,000, and by the end of the year it might be £20,000, and £40,000 was a moderate estimate of the extra dividends they would receive from associated companies, so why alter the policy of the board. They had £1,400,000 earning nothing, but that position was gradually improving. They only wanted patience.

The Chairman, in reply, said that if they did not receive the dividend it would make the financial position of the company more easier. He proposed to write down the securities, as they were over-valued at present on their books, and to that extent they had been using the money which had been set aside to reserve, received from the premiums on the capital issue, which would be using it properly for a capital purpose.

Mr. Garcke, in reply to Mr. Nicholson, said that as a result of the policy they adopted two years ago, their liabilities in regard to commitments were very much less.

The amendment, which had been seconded by Mr. Solomon, was then put to the meeting and lost, and the report was adopted.

J. G. White & Co.

The sixth annual meeting of the shareholders of this company was held on Thursday of last week at the offices, 22a, College Hill, Cannon Street, Lord Arthur Butler presiding, in the absence of the chairman, Mr. J. G. White.

In proposing the adoption of the report, the Chairman said that Mr. White was prevented from attending the meeting by important business, which had detained him in the United States. It gave him (Lord Arthur Butler) pleasure to meet the shareholders, and to be able to give them a favourable report as to the position of the company's business. The report and accounts spoke for themselves, and there was very little that he could add which would be of interest. The works which the company were carrying out continued to progress satisfactorily, and negotiations for procuring new business were progressing favourably. It was true that the field for work in the United Kingdom might be somewhat restricted at the

moment, due to competition and other causes, but on the other hand, the company's business had expanded to a marked degree in connection with foreign contracts, and they would see from the report that they were represented in a good many parts of the world. Generally, he might say that he looked forward with confidence to future progress, and judging from the present aspect of affairs, they had every reason to hope that the company's operations during the present year would be as successful as during the past year. To return to the accounts, there was possibly one item, viz., that of "investments" to which he might briefly allude. It might have occurred to them that the amount was somewhat large for a company of this nature, and in explanation he might say that the first item, "Waring White Building Co., Ltd., £25,000," was only another method of carrying on the building construction business which, in the ordinary course, would have been carried out by a department of that company. The Waring White Building Co. had since its inception carried out contracts aggregating over half a million pounds, with success, and now had work in hand amounting to upwards of £800,000. Its prospects were decidedly favourable, and the investment should prove a valuable asset in the future. The other securities represented to a large extent shares in sound undertakings which had been acquired in connection with the carrying out of works, and these were shown on the balance-sheet at a figure less than could be secured if the shares were sold at their current values.

Mr. W. C. Burton seconded the motion, and the report was adopted.

The Indian Electric Supply and Traction Co.

The ordinary general meeting of this company was held at Winchester House, E.C., on Friday of last week, Sir Walter R. Lawrence presiding.

The Chairman, in moving the adoption of the report, said that owing to unforeseen circumstances the reconstruction of their lines had not been able to be commenced as they expected in March last, but notwithstanding the ill-health of some of their staff the contractors were confident that the work would be completed by November 30th next. Their consumers would be able to have their electric fans at an early date, but he thought it was better that they should have a careful installation than a hasty and partial electric supply. A member of their firm, Mr. Shakespeare, was with them that day, and he had told the board that in Cawnpore their future prospects were very bright, many of the householders and one or two mills being almost certain at a near date to take electric light and power from them. He (the chairman) had recently had an opportunity of visiting their works at Cawnpore. The route which would be followed in the laying of their new lines was no doubt in the most crowded centres of Cawnpore. Their local agents had secured for them most excellent sites for their new generating station and car-sheds. Everything that he had seen had given him gratification, and he was sure that under the management of their future engineer, Mr. Atkinson, their prospects would even be better.

Mr. J. B. Stone seconded the motion.

Mr. Shakespeare said it was rather difficult to give any statement as to what were the prospects of the company. The population of Cawnpore were somewhat uneducated as to tramways, and it would take some time before the service would be used to its full capacity. The route ran through the whole of the city, and he thought that within those limits they would get all the traffic possible. They had in their minds one or two new schemes, but for the present they had decided to leave them until a more favourable time. With regard to their private supply, they had a large demand from householders, and there were several new Government offices being erected, and he thought they might consider that practically they would supply them and all the well-to-do householders. The factories, he thought, would all use their electric current for driving minor machines. He did not think that at first there would be a demand for the current to drive major machines, but they might do so in the future. The three railway yards all adjoined one another, and they were making arrangements for lighting them, but he could say nothing definite as the question of rates, &c., was still under consideration, but personally he thought the railway companies would take their current from them for lighting, and possibly for some of the pumping engines. They were entering into negotiations for the lighting of the streets, but as the city was not in a very strong financial position he did not think that would come about yet; however, the city had decided upon lighting two of the main streets, which would soon be put in hand.

The report was adopted.

United River Plate Telephone Co.

The directors' report states that the gross receipts in sterling for the year ended March 31st in the River Plate were £181,085, as against £151,085 for last year. Deducting debenture interest, dividend on preference shares, and interim dividend on ordinary shares, and adding interest on investments, transfer fees, &c., there remains a profit of £49,485, to which must be added £2,591 brought forward from the previous year, making an available balance of £52,077. After putting aside £15,000 for renewal of plant and transferring the sum of £15,000 to the reserve fund, the directors recommend that a final dividend of 5 per cent. be paid upon the ordinary share capital of the company, making, with the interim dividend paid December 30th last, a return of 8 per cent. for the year, free of income-tax, and that the balance of £2,077 be carried forward. During the year the cost of living in Argentina has steadily increased, and in consequence of this and of the scarcity of labour in certain departments considerable advances in wages have taken place. As anticipated last year, the continuous increase in the business of the company has necessitated further capital expenditure, and to meet this it is intended to make an immediate issue of £100,000 in ordinary shares, which will be offered to the ordinary shareholders at par.

Chili Telephone Co.

The directors' report for the year ended March 31st, 1906, states that the aggregate number of subscribers at all centres at the end of the year was 7,270, or a gain of 996. The gross revenue in Chili in 1905-6 was $1,090,569, an increase of $111,823. The expenditure was $501,032, an increase of $55,892. The net income was $589,536, an increase of $55,930. The balance to the credit of the revenue account, including £2,467 brought from the previous year, was £36,372, of which £16,119 has been carried to reserve. An interim dividend of 3s. per share, free of income-tax, was paid on January 15th last, and the directors now recommend a final dividend of 5s. per share, free of income-tax, leaving a balance of £2,653 to be carried forward. The total mileage is 12,373 miles, an increase of 1,613 miles.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to—

Canadian General Electric Co.—London certificates for 11,000 shares of $100 each, fully paid.

Electrical Development Co. of Ontario.—$2,500,000 first mortgage sinking fund 5 per cent. gold bonds of $500 each, Nos. 10,751 to 15,750.

And to allow the following to be quoted in the official list:—

Canadian General Electric Co.—36,000 shares of $100 each, fully paid.

Montreal Water and Power Co.—£270,000 first mortgage 4 per cent. prior lien gold bonds of £100 each, Nos. 1 to 2,700 (registered). (Renewed application.)

Eastern Extension Telegraph Co.—The directors have declared an interim dividend for the quarter ended March 31st last of 2s. 6d. per share.

British Automatic Telephone Co.—This company held its statutory meeting recently, Mr. R. C. Richards presiding.

Greenwood & Batley.—Mr. Arthur Greenwood presided at the annual meeting held at Westminster last Saturday. He said that there had been a falling off in the sales of upwards of £70,000, as compared with the previous year. A little more than a year ago there was a reported boom in the engineering trade. That certainly applied to the shipbuilding trade, but it had not yet extended to the engineering trades generally, except so far as to cause a very large advance in the prices of raw material, which had increased out of all proportion to the selling value of engineers' products. Their electrical plant was now fully at work. The progress of the De Laval Steam Turbine Co. continued, and the company was in a position to make larger turbines than formerly. Their new multiple steam turbines now under construction were of 1,500 H.P., and the directors looked forward to a growing trade in this direction. The report was adopted.

Telegraph Construction and Maintenance Co.—The directors have declared an interim dividend of 12s. per share.

Electric and General Investment Co.—Warrants for the dividends recommended in the report have been duly posted. The meeting was held on Wednesday.

Calcutta Electric Supply Corporation.—The number of units delivered to consumers during the four weeks ended May 25th, 1906, were 538,767, compared with 369,487 units in the corresponding four weeks of the preceding year.

City of London Electric Lighting Co.—Warrants in payment of a half-year's interest to June 30th, 1906, on the company's £400,000 5 per cent. first and £300,000 4½ per cent. second debenture stocks, have been duly posted.

Globe Telegraph and Trust Co.—The directors have declared a quarterly interim dividend of 2s. per share.

Electrical Power Storage Co.—A dividend of 6 per cent. on the ordinary shares for the year ended May 31st is recommended. This is at the same rate as for last year.

Prospectus.—*Highlands and Lowlands Para Rubber Co.*—This company has been inviting subscriptions for 63,546 shares of £1 each. The company is to purchase rubber estates and lands in the Federated Malay States totalling 14,669 acres, of which 1,958 acres are at present planted with rubber.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	* £	No. of wks.	Total to date. £	* £	Route miles open.	*
Aberdeen	June 27	2,870	— 178	4	5,612	— 246	14·4	..
Ayr	,, 23	722	+ 18	6	1,755	— 125	8	..
Bath	,, 27	1,692	+ 183	26	19,258	+ 2,858	13	..
Belfast	,, 29	6,781	+1,991	26	81,746	+22,092	40	+ 6½
Birkenhead	July 1	2,155	— 111	13	13,998	+ 146	13·5	..
Blackburn	June 27	2,142	+ 149	13½	14,315	+ 810	13·5	..
Blackpool Corp. ..	,, 28	2,235	—1,101	13	12,960	+ 598	11·87	..
,, —Fleetw'd	,, 30	1,620	— 153	26	10,783	+ 971	8·25	..
,, —Lytham	,, 28	1,005	— 379	34	9,388	+ 1,030	7½	..
Bolton	July 1	4,356	+ 138	13	28,411	+ 1,759	26	+ 1
Bournemouth ..	June 27	3,186	+ 326	12½	20,708	+ 5,489	18·75	+16¾
Bradford	,, 30	9,408	+ 564	13	60,840	+ 2,999	53	..
Brighton	July 1	2,073	— 64	13	12,711	..	9·5	..
Bristol	June 29	10,344	— 961	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	June 22	463	+ 46	25	5,458	+ 563	3·65	..
Barrow	,, 22	563	— 81	,,	5,763	+ 868	5·37	..
‡Birmingham (City)	,, 22	10,529	—2,555	,,	132,190	— 8,267	14·5	..
Birmingham (Mid.)	,, 22	2,840	—1,961	,,	35,236	—10,875	12·25	..
Devonport ..	,, 22	898	— 139	,,	10,758	— 442	8·85	..
Dudley—Sto'rb'ge	,, 22	1,620	— 946	,,	20,470	— 92	21·25	..
Gateshead	,, 22	1,879	— 93	,,	23,225	+ 1,096	11·25	..
Gravesend, N'fleet	,, 22	516	— 88	,,	5,548	+ 253	6·5	..
Greenock	,, 22	1,616	+ 104	,,	15,795	+ 890	7·25	..
Hartlepool	,, 22	599	— 59	,,	6,813	+ 561	6·72	..
Leamington	,, 22	395	+ 252	,,	3,892	+ 2,175	3	..
Merthyr	,, 22	387	— 55	,,	4,752	+ 23	2·9	..
‡Metropolitan ..	,, 22	7,608	+ 51	,,	80,457	+24,411	22	..
Middleton	,, 22	982	+ 23	,,	8,348	+ 430	8·5	..
Oldham — Ashton	,, 22	1,261	— 24	,,	13,709	+ 532	9·13	..
Peterborough ..	,, 22	258	— 156	,,	2,898	— 259	5·31	..
Potteries	,, 22	8,382	— 259	,,	43,730	+ 2,342	29	..
Rothesay	,, 22	741	+ 307	,,	3,090	+ 839	2·75	..
Southport	,, 22	793	— 326	,,	7,167	+ 102	8·17	..
South Staffs. ..	,, 22	1,539	+ 293	,,	19,981	+ 2,721	13·87	..
Swansea	,, 22	1,719	— 245	,,	19,471	+ 4,412	5·5	..
Tynemouth	,, 22	593	— 237	,,	5,229	— 125	3·75	..
Weston-s-Mare ..	,, 20	417	— 84	,,	1,904	+ 68	3	..
Wolverhampton D.	,, 22	770	— 340	,,	10,111	+ 833	14·75	..
‡Worcester	,, 22	599	— 223	,,	6,489	— 602	5·75	..
Yorks. Wool. Dist.	,, 22	1,973	+ 326	,,	21,820	+ 6,613	17	..
Miscellaneous ..	,, 22	4,255	— 257	,,	48,151	+ 176	..	..
Burnley	,, 20	2,362	+ 134	25	..	..	7·5	..
Burton-on-Trent ..	July 1	625	— 30	13	3,965	— 287	8·5	..
Bury	June 24	2,088	..	12	12,196	..	10·5	..
Cardiff	,, 23	4,246	— 658	12	24,827	— 344	15·87	..
†Carlisle	,, 23	197	— 21	25	4,313	+ 45	..	..
Chatham and Dist.	,, 28	1,315	— 58	26	16,030	— 26	10·29	+ ·96
Colchester	Mar. 7	327	— 5	31	5,660	..	7½	+ ½
Cork	June 28	1,082	— 93	26	11,696	— 303	9·9	..
Croydon	,, 29	3,144	+ 190	4	6,960	+ 746	11·25	+ ·5
Darlington	,, 30	440	+ 24	13	2,749	+ 118	4·87	..
Darwen	,, 29	507	+ 10	13	3,325	+ 96	4·36	..
Dover	,, 30	574	+ 77	13	3,226	+ 408	4·75	+ 1½
Dublin	,, 30	12,147	— 229	26	126,311	+ 933	48·5	+ ·5
Dundee	,, 27	2,193	+ 449	26	6,653	+ 1,324	12·5	..
East Ham	,, 30	1,933	+ 152	13	12,969	+ 1,303	8	+ ½
Exeter	,, 29	400	— 24	13	3,727	— 391	4·25	..
Glasgow	,, 30	34,151	+1,286	5	77,827	+ 5,283	80·25	+ 4½
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	June 27	3,487	+ 203	13	21,931	+ 1,298	37	+ 1·5
Hastings	,, 29	759	..	..	..	..	..	..
Huddersfield ..	,, 30	3,656	+ 345	13	20,096	+ 2,201	28	..
Hull	,, 30	4,585	+ 251	13	29,125	+ 695	13	..
Ilford	,, 30	1,048	+ 4	13	6,684	+ 209	6·37	..
Ilkeston	,, 28	276	+ 22	13	1,688	+ 40	3·5	..
Ipswich	,, 30	956	— 19	13	5,625	— 80	10·5	..
Isle of Thanet ..	,, 30	1,706	..	26	10,174	— 399	11	..
Kilmarnock	,, 30	313	— 15	7	1,034	— 56	4·12	..
Kirkcaldy	,, 27	444	+ 6	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 28	1,789	+ 382	26	22,240	+ 5,080	12·5	+ 3·9
Leeds	,, 23	12,572	—1,076	12	76,003	+ 4,487	96·5	+ 7½
Leicester	,, 30	4,805	+ 131	26	56,107	+ 4,457	..	..
Leith	,, 23	1,045	+ 559	5½	2,972	+ 1,607	6	+ 1
†Liverpool	,, 16	10,932	—1,957	24	251,998	+ 5,701	104	+ 1
‡L.C.C.	,, 16	56,701	..	12	292,210	..	95½	+48¾
London United ..	,, 29	14,467	+1,148	26	151,517	+ 8,921	..	..
Lowestoft	,, 17	362	— 76	38	5,004	— 299	3·5	..
Manchester	,, 30	27,553	+ 998	13	176,896	+ 9,663	84	..
†Newcastle	,, 23	3,942	+ 223	12	47,278	+ 2,093	25·5	..
Newport	,, 23	1,273	— 205	12	7,593	+ 357	14·5	+ 1·5
Northampton ..	,, 29	904	— 7	13	5,743	+ 24	5·5	..
Oldham	July 1	3,648	+ 301	14	25,034	+ 2,080	23·75	..
Pontypridd	June 30	315	+ 7	13	2,268	— 19	3·5	..
Portsmouth	,, 30	4,241	— 318	13	25,733	— 179	14·5	..
Preston	,, 27	1,494	+ 153	..	..	..	10	..
Reading	,, 28	1,350	— 5	13	8,073	+ 30	7·5	..
Rochdale	,, 30	2,042	+ 338	13	13,881	+ 5,019	20·6	+ 1·7
Rotherham	,, 28	952	+ 106	13	6,357	+ 620	9·3	..
Salford	,, 25	8,902	—1,399	12	55,714	+ 1,033	38·9	..
Sheffield	July 1	10,716	+ 838	14	73,752	+ 5,237	35·75	+ 1½
Southampton ..	June 27	2,012	— 52	12½	12,091	+ 51	..	..
†Southend-on-Sea ..	,, 27	438	— 1	13	4,681	+ 164	6	..
†Stalyb'dge, Hyde, &c	Apr. 21	807	+ 100	3	2,456	..	21	..
†Stockport	June 15	1,263	+ 255	11	10,892	+ 4,132	15·5	+ 4
Sunderland	,, 17	3,254	+ 62	11	15,225	+ 830	10·87	..
Swindon	,, 13	553	+ 118	10½	2,158	+ 77	4·4	..
†Tyneside	,, 20	394	+ 17	25	9,924	+ 517	8·87	..
†Walthamstow ..	,, 23	753	..	12	7,599	..	10	..
Warrington	Mar. 29	677	+ 43	52	17,804	+ 1,247	6·37	+ ·25
West Ham	June 28	4,728	+1,348	13	29,848	+ 9,687	14·7	+ 3¾
Wolverhampton ..	,, 27	1,616	..	..	..	..	10	..
Yorks. W. Riding ..	July 1	1,652	+ 3	26	20,385	..	..	..
Baker St.-Waterloo	June 30	2,777	..	16	23,118	..	3·25	..
Cen. London Rly. ..	,, 30	12,123	— 808	26	172,963	— 5,889	6	..
City & S. Lon. Rly.	July 1	4,920	+ 245	26	72,350	+ 329	6·25	..
Dublin-Lucan Rly.	June 30	293	— 24	26	2,815	— 174	7	..
G. N. and City Rly.	,, 30	3,449	+ 391	26	46,477	+ 2,740	3·5	..
†L'pool Overb'd Rly.	,, 24	1,509	— 93	25	35,461	— 2,559	6·65	..
Mersey Railway ..	,, 30	3,437	+ 203	26	45,098	+ 3,015	4·5	..
Metropolitan Rly. ..	July 1	31,960	—4,411	26	423,588	—30,915	70·5	..
Met. District Rly. ..	,, 1	16,040	+1,355	26	208,861	+14,735	24	..
Anglo-Argentine ..	,, 1	26,337	+1,399	26	985,606	+89,904	43	..
§Auckland	June 22	10,225	+1,319	25	61,419	+ 4,193	18·64	..
§Brisbane	May	11,691	+ 776	..	..	..	..	..
§Brit. Columbia Rly.	,,	18,545	+3,681	48	215,505	+44,078	..	..
†Bu'n's A'r's E.T.Co.	June 2	1,257	+ 165	21	30,835	+ 6,182	24	..
Bu'n's A'r's-Blgr'no	,, 24	6,775	+ 120	25	89,273	+ 5,800	..	..
Calcutta	,, 30	5,628	+ 161	..	..	..	..	..
§Cape Electric T. Ld.	May	14,806	..	..	..	..	..	..
§Geneva	,,	7,977	+ 195	..	..	..	..	..
Perth (W.A.) ..	June 29	2,784	+ 345	26	38,937	+ 2,309	24·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Fraught with interest as the last few days have been to the electric lighting world by the issue of the Hybrid Committee's recommendations respecting the supply of power to the metropolis, its effect upon the share market has been nearly negligible. Although the County Council's Bill is shelved, there can be little doubt that a larger one will come forward. Mr. Luke White, M.P., the Chairman of the Committee, told the *Westminster Gazette* last Saturday that the Report is in reality a postponement, not a rejection of the measure. He proceeded to say, amongst other things, that the interests of shareholders in the private companies and those of the local ratepayers would be equally protected, from which remark it might be unsafe to infer that Mr. Luke White, M.P., is a large shareholder in any of the metropolitan undertakings.

The net result, then, is, so far, practically *nil*, in regard to quotations. Metropolitan Ordinary rose 5s., and Smithfields fell the same amount. That is the only visible change. Amongst other electric lighting shares, Urban Ordinary are harder at 3½, but Hove lost a fraction at 8. Notting Hill shares remain at 14, *ex* the dividend of 6s. per share just deducted. A number of other dividends came off at the end of last week, and of these the majority were concerned with Debenture stocks.

Inside support for British Electric Traction was forthcoming after the meeting, and the Ordinary are a shade harder at 5¾, while the Preference at 9¼ are also better. The chairman dealt tenderly with the worst points in the balance-sheet, but some of the shareholders spoke their minds with considerable force. If the price rises a little further, the more timid proprietors will probably ponder over the advisability of cutting their loss. Though these shares are firmer, British Westinghouse Preference are down again to 27s. 6d., but of the fall of 3 in the Debenture stock 2 per cent. represents the deduction of the interest-payment. London United Tramways Preference are *ex* 5s., and the price has been marked down 15s. to 8¼. This particular group is not noted for its strength at the present time. The Brush issues continue unaltered. Other changes in the traction department include ⅛ fall in Anglo-Argentine Tramway Ordinary shares, and ¼ fall in Calcutta Trams. Metropolitan Electric Tramways issues are the same as last week. From a source which should be peculiarly well-informed, we hear that the Highgate disaster is reckoned to be likely to cost not less than £10,000.

British Columbia Electric Railway stocks exhibit firmness in the face of the directors' decision to reduce the company's lighting rates, as from last Sunday, a step that may entail a loss of £15,000 per annum, unless new business springs up—as of course in time it will do—to counteract the reduction in charges. The scheme for "harnessing" the Victoria Falls on the Zambesi River in order to supply power to the Randt is again to the fore, and British manufacturers are being told that they have not lost much in failing to secure a contract of doubtful financial worth.

Anglo-American Telegraph Deferred at 23⅝ is down 1½, and West India and Panama shares are lower. The 4 per cent. bonds of the American Telephone and Telegraph Collateral Trust are now officially quoted at 95. National Telephone Deferred eased off to 107½. Telegraph Constructions are unaffected by the declaration of the interim dividend, but Manufacturing shares, on the whole, show dulness. Cromptons are easier, and so are Edison & Swan shares.

In the face of Home Railway depression, electrical stocks are unable to improve. City and South London is down to 40, Great Northern and City Preferred to 3¾, while the two Undergrounds are both lower at 66 for Metropolitans and 24 for Districts.

South Wales Electrical Power Distribution Co.—

The *Western Mail* says that a special general meeting of shareholders was held on 3rd inst. at Cardiff. Mr. Robert Forrest, J.P., presided, and moved the following resolution:—

"The company's Bill, now pending in Parliament, with the additional provision and new clauses inserted therein, authorising the raising of additional capital by the creation and issue of £500,000 prior lien debenture stock, ranking both as to principle and interest in priority to the existing debenture stock, and as a first charge upon the property and undertaking of the company, having been submitted to this meeting of shareholders, it is resolved that this meeting of shareholders hereby approves the same, subject to such alterations as may be made in the Bill by Parliament and approved by the directors."

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 27th.	Closing Quotations July 3rd.	Business done week ended July 3rd, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	80 — 85 xd	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	22½%	31½%	66 — 68	65½ — 67½	66¾	66½	— ½
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	6 %	113 —114	112½—113½	113⅝	112½	— ½
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1½%	25 — 25¼	23½— 23⅝	25/16	23¾	—1⅜
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	102½	102½	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
1,982,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	98 — 100	97 — 99 xd	98½	97⅞	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8½ — 9	8½ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½ — 9	8½ — 9	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	98 —101 xd	..	..	..
60,710£	Direct United States Cable	20	8½%	8 %	8½%	8⅜%	15½ — 16	15½ — 16	15⅛	15⅛	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½%	4½%	4½%	4½%	101 —103	99½ —101½ xd	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	142 —145	142 —145	144	143	..
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90 — 92	91	90½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	107⅛	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14 — 14½	14 — 14⅜	14⅜	14⅜	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	106¼	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅜%	5½%	10⅞ — 11⅛	10⅞ — 11⅛	11⅛	10⅞	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14⅜ — 14⅝	14⅜	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	39 — 41	39 — 41	..	..	..
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	101 —103	99½ —101½ xd	101	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	57 — 59	57 — 59	58¼	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	¾ — 1	¾ — 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1⅛ — 1 1/16	1⅛ — 1 1/16	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —112	110 —112	110¾	108	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	107 —109	106½ —108½	108	106	— ½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14	12 — 14	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5½ — 5⅝	..	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	96 — 98 xd	97½	..	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —106	102 —104 xd	103¾	102½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1 5/16 — 1 7/16	1 5/16 — 1 7/16	26/10½	..	..
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	99 —101	97 — 99 xd	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	101 —104	99 —102 xd	..	..	..
11,889£	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7⅝	7½ — 7⅝	7⅝	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	101 —104 xd	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅛ — 5⅜ xd	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	108 —111 xd	..	..	..
15,609£	West African Telegraph, Shares	10	2½%	4 %	4½%	4 %	9½ — 10 xd	9½ — 10 xd	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	⅞ — 1	⅞ — ⅞	15/-	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	101 —104	99 — 102 xd	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	5 %	13⅞ — 14⅜	14⅛ — 14⅜ xd	14⅞	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	101 —103	101 —103 xd	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	104 —107	102 —105 xd	102¾	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	7/16 — 9/16	⅜ — ½	..	..	— 1/16
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	6⅛ — 7	6 — 7	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5⅛	4½ — 5⅛	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	99 —102 xd	..	..	..

* Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	8 %	6 15/16 — 7 1/16	6 15/16 — 7 1/16	7 3/16	6⅞	— 1/16
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	6⅛ — 6⅜	6⅛ — 6 xd	5 15/16	5 15/16	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	140 —143	138 —141 xd	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	102 —104 xd	..	..	..
800,000	Babcock & Wilcox, 1 to 590,000	1	..	17 %	20 %	20 %	3⅞ — 4	3⅞ — 4	78/1½	76/3	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	2¼ — 2⅜	3¼ — 4	78/1½	77/6	+1½
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6 — 6⅛	6 — 6¼	6¼	6¼	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5½ — 5⅝	5½ — 5⅝	5⅝	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —104	100 —104	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	115 —118	115 —118	116	115½	..
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	108	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105	103 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5 — 6	5½ — 6	5⅞	5 1/16	+ 1/16
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %‡	8½ — 9½	9 — 9½	9⅜	8⅞	+ ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	109 —113	109 —113	112	110	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92 — 95	10 — 93	91	90½	—2
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6½ — 7	6½ — 7	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5½ — 6½	5½ — 6½	6	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	104 —107	102 —105 xd	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	26/3	..	— ⅛
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	77 — 83 xd	78	77	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16 — ⅝	9/16 — ⅝	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1¾ — 2	1¾ — 2	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	84 — 86	82 — 84 xd	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 5/16 — 3 7/16	3 5/16 — 3 7/16	67/6	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	6⅜ — 5⅝	6⅛ — 5⅝	5 13/16	..	— ⅛
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	104 —106 xd	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	103 —106	101 —104 xd	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅛ — 9	8⅛ — 8⅜	8⅜	..	— ⅛
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	8⅛ — 8⅜	8 — 8⅛ xd	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	105 —108	103 —105 xd	104½	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½ — 11½	10½ — 11½	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅞ — 6	5⅞ — 5⅞ xd	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	109 —111	107 —109 xd	..	..	..
491,229	Cape E. Trams., 1 to 491,229	1	..	15 %	10 %	5 %	⅜ — ⅝	⅜ — ⅝	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	22/3	..	..
220,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	100½	100	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86⅜	85½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
570,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	74 — 77	74 — 77	..	..	..
1,480,000	City and South London Railway	Stock	3½%	2⅝%	2½%	1⅝%	40 — 42	39 — 41	41¾	40	—1
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	1⅝ — 2⅛	1 1/16 — 1 1/8	..	..	— 1/16
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	94 — 97 xd	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations June 27th.	Closing Quotations July 3rd.	Business done week ended July 3rd, 1906. Highest.	Lowest.	Rise + or Fall —
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅜ — 1⅞	1⅜ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —107	103 —106 xd	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14⅜ — 15⅜	14 — 15	14¼	..	— ⅛
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½—100½	99½—100½	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	95 —100	95 —100	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅛ — 1⅜	1⅛ — 1⅛	29/4½	..	— ⅛
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2½ — 3	2½ — 3	..	..	..
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	85 — 87 xd	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅞ — 1	⅞ — 1	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	2 — 2½	2 — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	88 — 91	88 — 91	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼ — 9½	9 — 9⅛ xd	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	93 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3⅜ — 4⅛	3⅜ — 4	..	..	— ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10⅜ — 11⅛	10⅜ — 11⅛	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	100 —101	100 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	..	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5½	5¼ — 5½	..	..	..
41,978	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	108½	107	..
108,022	Do. do. Scrip. All paid	..	..	..	..	..	107 —109	107 —109	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18 xd	17 1/16	17¼	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	Nil	Nil	1½ — 1¾	1½ — 1¾	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4 — 5	4 — 5	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8½	8 — 8½	..	..	..
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	4 — 5	4 — 5	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8⅝ — 9⅛	7¾ — 8⅝xd	8	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	96 — 99	94 — 97 xd	95⅝	95¼	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅛ — ¼	⅛ — ¼	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	102 —104	100 —102 xd	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4⅝ — 4¾	4⅝ — 5⅛	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	7 — 8	7 — 8	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7¾ — 8⅜	7¾ — 8⅜	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32 — 34	32 — 34	..	..	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	102 —104	100 —102 xd	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	94 — 96	94 — 96	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	8 %	Nil	Nil	1¼ — 1⅜	1¼ — 1⅜	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2⅜ — 2¾	2⅜ — 3⅛	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	78 — 83	78 — 83	..	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅛%	4 %§	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8 — 9	8 — 9	8⅜	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	104 —103	100 —103	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4 — 5	4 — 5	89/9	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4¼ — 4⅜	4¼ — 4⅜	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4¼ xd	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4¼ xd	77/6	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —102 xd	99 —102	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5⅜	5 11/32	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	106 —108 xd	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10½ — 11¼	10½ — 11¼	11	10 13/16	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	..	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	121 —124 xd	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	99 —102 xd	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 1/16 — 3 3/16	2 1/16 — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 9	8 — 9	8⅜	..	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11½ — 12¼	11½ — 12¼	11 11/16	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	107 —110 xd	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —104	..	..	+ ⅛
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	3⅜ — 4¼	3⅜ — 4¼	..	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4½ — 5	4½ — 5	..	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5¼	5 — 5¼	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8 — 8½	7¾ — 8¼	8 1/16	..	— ¼
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7 — 7½	7 — 7½	..	..	..
37,393	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —101	96 — 99	..	..	—2
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98 —101	96 — 99	..	..	—2
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12%	12 %	10 %	10 — 11	10 — 11	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2 — 2⅜	2 — 2⅜	43/9	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5 — 5⅜	5 — 5⅜	..	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 —100 xd	96 — 99	..	..	—1
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8 — 9	8½ — 9¼	..	..	+ ¼
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝ xd	..	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	109 —113 xd	109	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	94 — 96 xd	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	100 —103	98 —101 xd	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8¼	7⅞ — 8⅛	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅛ — 6¼	5⅛ — 6¼	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½ xd	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10½ — 11½	10½ — 11½	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	95 — 97 xd	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼ — 2⅜	2 — 2⅛	..	..	— ⅛
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	8 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..
103,700	South Met. Elec. Lt. & Power (Late Blackheath and Greenwich Dist. E.L.Co.) Ord.	1	Nil	Nil	Nil	2½%	⅜ — ⅝	⅜ — ⅝	..	..	..
85,368	7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
148,292	4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 3⅜	3⅛ — 3⅜	..	..	+ ⅛
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	100 —102	100 —102	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	10¾ — 11¼	10½ — 11¼	11⅛	..	+ ⅛
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 5/16 — 5 5/16	6¼ — 5⅜ xd	5 5/16	5 5/16	..

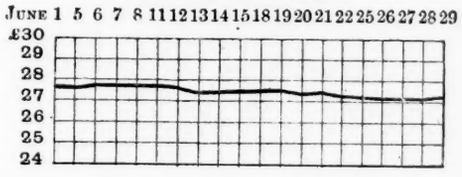
Shares not officially quoted:—Mackay Companies, ord., 72—74. Pref. 72—74.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 3½ per cent. June 21st, 1906).

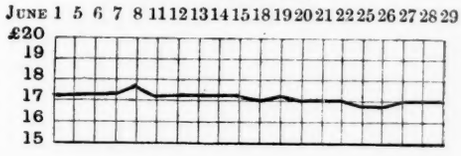
METAL MARKET.

Fluctuations in June.

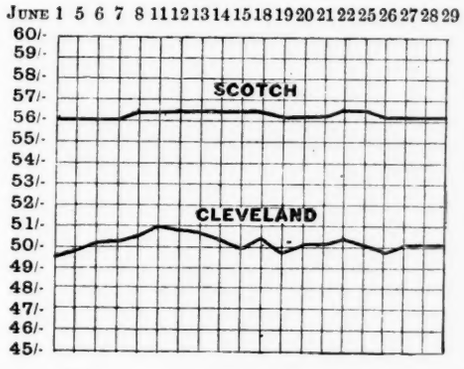
SPELTER (G.O.B's.)



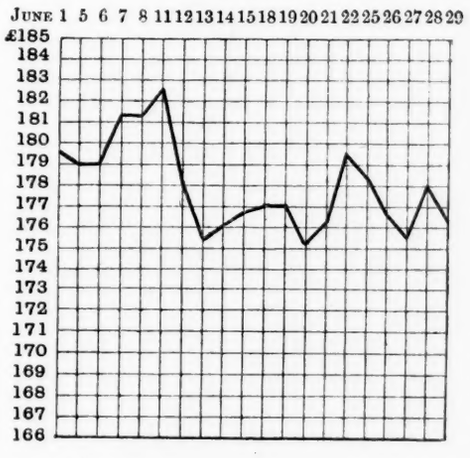
LEAD (ENGLISH)



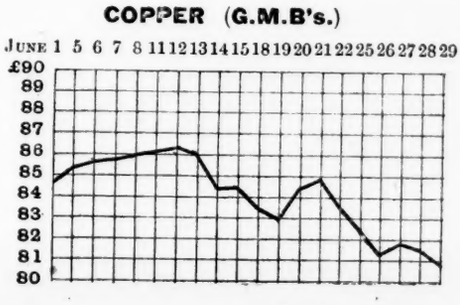
IRON.



TIN.



COPPER (G.M.B's.)



PARK ROYAL POWER STATION AND THE HAMMERSMITH AND CITY ELECTRIC RAILWAY.

(*Concluded from Vol. 58, page 993.*)

The boiler house contains 10 Babcock & Wilcox water-tube boilers arranged in two rows of five. Each boiler is fitted with a superheater, and has sufficient heating surface to render the use of economisers unnecessary. A main flue is carried at the back of each row of boilers to the east end of the boiler house, where a cross flue passes just outside the end wall of the boiler house. This connects the two main flues, which are carried into a square chimney 250 ft. high and 12 ft. across internally.

The working pressure of the boilers is 200 lb. per sq. in. Each boiler is guaranteed to evaporate 19,200 lb. of steam per hour, from and at 212° F. The steam as it leaves the boilers will be superheated 150° F.

Each boiler is fitted with a mechanical stoker of the chain grate type worked from a shaft which runs overhead. The shaft in front of each row of boilers is driven by a three-phase induction motor working at 650 volts. Worm reduction gear is used, and an arrangement of claw clutches enables a spare motor to be brought into use when required, driving the shaft from the opposite end.

A duplicate set of feed pipes is carried from the pump room at the west end of the boiler house along the front of each line of boilers. These pipes are connected across the boiler house at the east end, and also in the pump room, so as to form a complete duplicate ring. The boilers and feed pumps are connected to both rings, and the valves are so arranged that all water for the boilers can be measured by water meters. The feed pump suctions are carried into the two large hot well tanks in the basement of the boiler house under the pump room floor. The feed pumps can also draw direct from the water supply pipe or from the circulating water pipes leading from the cooling tower tanks.

The coal is brought to the station over the Great Western railway, in special steel wagons holding 20 tons each. These are shunted on to the siding over the large coal silo at the east-end of the boiler house. This silo consists of a row of funnel-shaped bunkers formed of reinforced concrete, below which is a tunnel running from end to end of the silo. The whole of the silo is built below rail level, the ground having been excavated, so that the coal can be discharged by gravity from the wagons, which are made with bottom doors.

Two tray conveyors are placed in the tunnel under the silo hoppers, by which the coal is brought from the bottom of any one of the hoppers to the bottom of two vertical bucket elevators which rise out of the centre of the silo. The coal is raised in this way to a height of 50 ft. above the boiler house floor level, where it is discharged into two bucket conveyers running parallel to the centre line of the boiler house. Each tray conveyer and bucket elevator is driven by one three-phase induction motor working at 650 volts. Each bucket conveyer is driven by its own motor, and is not geared in any way to the elevator. Any surplus coal elevated falls by gravity again into the silo. Each bucket conveyer passes over an automatic weighing machine of Messrs. S. Denison and Son's make, which automatically registers the weight of coal passed from the silo into the boiler house. The bucket conveyers run over a gantry from above the coal siding into the boiler house, where they pass over a row of large steel hoppers into which the coal is discharged. These hoppers are built over the boilers, and form a coal store from which the coal falls by gravity through measuring boxes into the hoppers of the chain-grate stokers. The bucket conveyers, after passing over the coal storage bunkers, pass down vertically through the pump room end of the boiler house to the basement, along which they return under the boiler house floor. The ashes from the boilers are filled into the conveyers as they pass below the boilers, and are so taken back to the railway siding, over which they are discharged into a large steel hopper. From this ash hopper they can be discharged by gravity into wagons. The whole of the conveying and elevating plant for handling the coal has been made and erected by Messrs. J. Spencer & Co., of Melksham.

The coal-measuring boxes, of which there is one in front of each boiler, are of the Klein Engineering Co.'s revolving box type made by Messrs. Babcock & Wilcox, and are fitted with adjustable shutters for altering their capacity, and with counters for registering the number of times each box is emptied.

H.T. Transmission.—The H.T. three-phase supply is transmitted at 6,600 volts from Park Royal to the sub-stations by the main feeders previously mentioned above. Each feeder has three cores of 0·15 sq. in. sectional area, insulated with paper, lead-sheathed, and protected by an armouring of galvanised wire. The whole of the cables have been supplied and laid complete by Messrs. Siemens Bros. & Co., Ltd. The cables are all laid in Howard asphalte troughing, a separate trough being used for each cable. These troughs are filled in with bitumen, and covered with a layer of asphalte concrete carried over all the troughs, so as to form a waterproof covering. The trenches in which the troughing is placed are excavated about 2 ft. deep, and have a 4-in. layer of concrete laid in the bottom to form a bed for the troughing.

Where the cables have to cross any railway lines, a trench is excavated and floored with concrete, brick walls are built up at the side, and on the top are laid old rails or steel troughing to form a floor for the sleepers and rails. In this way all weight and pounding from the passing trains is kept off the cables.

At Old Oak Common and at Westbourne Park the cables enter a small brick building already referred to as the Inspection Chamber, in which any incoming feeder can be joined to any outgoing feeder by a simple arrangement of plugs and switches. In this way it is possible to keep one or more cables as spare in any section, and connect them to the spare cable in the next section, or to any other cable or sub-station as may be necessary.

The route chosen for the feeders has, as far as possible, been at the side of the line, so that any repairs, examination or jointing can be done with greater ease. In certain places, however, more particularly between Westbourne Park, Royal Oak, and Shepherd's Bush, it has been necessary to lay the feeders in the 6-ft. way. All the laying and jointing had to be done without interfering with the traffic, and great care had to be taken to avoid accidents. We are glad to say that not a single life was lost in carrying out this part of the work.

There is one point of special interest in connection with the way in which these cables were jointed. The usual method of jointing the cables after they had been laid was departed from, as it was considered that a much better joint would be made if more space were given to the jointer than is possible after the cables are laid, and where there are a number placed side by side. The method adopted in the present instance was to leave the last 20 or 30 ft. of each length of cable unlaid until the end had been jointed to the next length of cable to be laid in the same trough. The trench was covered over with a platform of boards for about 10 ft. on either side of where the joint was to be made. The ends of the two cables to be jointed were laid on this platform, and all jointing done where there was ample room and things could be kept clean. The completed joint was covered with a lead sleeve filled with compound, and wiped to the lead sheath of the cable. The outside diameter of the joint was a little less than the width of the trough, so that it could be lowered into position wherever it came in the trough, and the laying of the next length of cable be proceeded with.

The high and low-tension cables from the sub-stations to the distributing centres, and to the conductor rails of the Hammersmith and City Railway, &c., were laid in exactly the same way as described above, but concentric lead-covered cables are used for the low-tension direct current, and for the low-tension alternating current. No armouring is provided on these cables, as was done on the high-tension feeders, in order to meet the requirements of the Board of Trade. The same trenches are used wherever possible for the cables entering and leaving the sub-stations.

Sub-Station Plant.—The three sub-stations are designed on exactly the same lines, although they are of different lengths to suit the number of motor-generators installed. Each sub-station consists of three bays. The centre bay is for the motor-generators, over which is a travelling crane. One side bay contains the H.T. switchboard, and the other the L.T. switchboards. In this way the sub-station can be extended, the switchboards growing as additional motor-generators are put in. The incoming H.T. feeders are carried direct to the high-tension board, which is similar to the Park Royal board already described. It is fitted with duplicate bus-bars, and sectionalising switches to facilitate cleaning. The feeders are connected to the bars in the centre of the board with the motor-generators at one end, and the branch circuits, or feeders, to the H.T. distributing centres at the other end. All the H.T. boards at the sub-stations have been supplied by the B.T.-H. Co.

The L.T. switchboards, which are placed exactly opposite the H.T. boards, are separated, so that all switch-gear and instruments for controlling the supply to the Hammersmith and City Railway are on one board (referred to as the traction board), and the D.C. supply for arc lighting is controlled by a separate or lighting board. Both these boards are of the usual type with single bus-bars.

One point of special interest is the use of large batteries at Shepherd's Bush and Royal Oak which will be worked in parallel with the motor-generators on the traction board supplying the railway. The batteries are of the Tudor Co.'s make, that at Royal Oak having a capacity of 840 amperes for one hour, and that at Shepherd's Bush 1,680 amperes for one hour. Each battery is connected to the traction board through a Highfield automatic reversible booster. The batteries are intended primarily to equalise the load on the motor-generators by taking the peaks when trains are starting, &c. It is, however, further intended to use the batteries in case of emergency for maintaining both the alternating and direct-current lighting supply. This is done by connecting the battery when required direct to the D.C. lighting board, and also by using the battery to run the motor-generators reversed, should the H.T. supply from Park Royal be at any time cut off. The motor-generators would, in this case, take current from the battery on the D.C. side and deliver alternating high tension current on the A.C. side to the H.T. switchboard, from which it would be transmitted as before to the distributing centres where it is transformed down and used for incandescent and arc lighting. Under these conditions the drain on the battery might be too great, and it is, therefore, arranged that the supply to the railway is automatically cut off entirely should the current from the battery exceed a pre-determined amount. In this way the battery would be able to maintain the lighting supply to Paddington and the other railway stations and goods yards until the supply from Park Royal was restored. A short interruption to the running of the Hammersmith and City line would be a small matter, compared to the extinction of the whole of the lights.

All the L.T. switchboards and Highfield boosters at the sub-stations have been supplied and erected by the Electric Construction Co.

The motor-generators are of the La Cour motor converter type built by Messrs. Bruce Peebles. There are seven 400-KW. sets at Shepherd's Bush, four 400 and two 200-KW. sets at Royal Oak, and one 400-KW. and two 200-KW. sets at Old Oak Common sub-station. The chief peculiarity of these machines is that they can be started on the high tension side exactly as if they were induction motor-generators, but they are capable of being reversed and generating A.C. current exactly as if they were synchronous motor-generators. This peculiarity is of special advantage in the present instance where batteries are being used as a stand-by for maintaining the alternating current lighting supply.

Distributing Centres.—There are in all some 11 distributing centres supplied with high-tension 6,500-volt three-phase current from the sub-stations. Each centre consists of a small brick room or chamber measuring about 20 ft. by 12 ft. by 9 ft. high. Two H.T. feeders enter each distributing centre. Each feeder is connected through a hand-operated oil break switch to the primary windings of a group of three single-phase step-down transformers. The three transformers of each set are connected in delta both on the primary and secondary sides. The secondaries from each set are taken to a L.T. automatic switch which connects them to a set of L.T. bus-bars. The two groups of transformers

in each distributing centre are therefore only connected in parallel on the L.T. side. The ratio of transformation is from 6,500 to 110 or 220 volts, according to the pressure required for the incandescent lighting. The two pressures are required to suit the wiring of the buildings, which has been done at different times. Gradually the whole of the wiring and lamps are being changed over to work at 220 volts.

The size of transformer used at the different distributing centres is chosen to suit the demand, each set of three transformers being of sufficient capacity to supply the maximum demand. The second set of transformers is provided as a stand-by. In order to avoid the expense of keeping a man at each distributing centre to change over from one set of transformers to the other in case of failure or other trouble, it is intended to control the whole of the distributing centres from one or other of the three sub-stations. This is accomplished in the following way :—

The two feeders carried from the sub-station to the distributing centre are connected independently one to each group of transformers, and the primaries of each group can therefore be switched on and off at the sub-station. At the sub-station end the feeders are always worked off the same bus-bars, and the primaries and secondaries of the transformers must, therefore, always be in phase at the distributing centres. There is, therefore, no difficulty in paralleling at the distributing centre by means of an automatic cut-in switch between the transformers and the L.T. bus-bars on the secondary side. As soon as one set of transformers is energised from the sub-station, the automatic switch is closed on the L.T. side by a solenoid made alive from the transformers themselves. As soon as the switch is closed, the solenoid is cut out of circuit and the L.T. switch held closed by a catch. The catch is tripped by a no-voltage coil, so that when the supply to the set of transformers is cut off at the sub-station and the transformer voltage dies out, the automatic switch is tripped. When the two sets of transformers have been switched into parallel, opening the switch at the sub-station in the primary circuit of one will not disconnect it at the distributing centre, because the secondary winding will be kept energised from the L.T. bus-bars, so that the no-voltage coil does not come into action to trip the automatic switch. In order to overcome this difficulty, a discriminating transformer of Mr. Andrews's design, and supplied by Messrs. Cowans, is connected so that when only one set of transformers is delivering power to the bus-bars, a relay circuit is brought into action which short-circuits the tripping coil of the L.T. automatic switch of the other or idle transformers, and so disconnects them. With this arrangement it will be seen that it is possible to switch in or out from the sub-station either set of transformers in any order, paralleling them when required for changing over or for taking the peak load.

The buildings for the generating station and sub-stations have been provided under the supervision of Mr. W. Y. Armstrong, the company's new works engineer.

The whole of the rest of the work described above was carried out to specifications prepared by Messrs. Kennedy and Jenkin, acting as consulting engineers to the Great Western Railway Co. The following is a list of the contractors :—

Boilers	Messrs. Babcock & Wilcox.
Engines and generators, auxiliary and condensing plant	The Electric Construction Co.
Overhead electric cranes ...	Messrs. Marshall, Fleming and Jack.
High tension, auxiliary and low tension switchboards at Park Royal	The British Thomson-Houston Co.
Pipework	Messrs. Aiton & Co.
Cooling towers	Messrs. Klein Co.
Coal conveyers and elevators ...	Messrs. J. Spencer & Co., Melksham.
Coal measuring boxes	Messrs. Babcock & Wilcox.
High and low tension feeders and distributing cables	Messrs. Siemens Bros.
Hand cranes at sub-stations ...	Messrs. Marshall, Fleming and Jack.
Motor-generators at sub-stations	Messrs. Bruce Peebles.
High tension switchboards at sub-stations	The British Thomson-Houston Co.
Low tension switchboards and Highfield boosters at sub-stations	The Electric Construction Co., Ltd.
Batteries at Park Royal and sub-stations	The Tudor Co.
High and low tension switchboards and static transformers at distributing centres	The Electric Construction Co., Ltd.
The lighting and power circuits at Park Royal and sub-stations	The Westminster Engineering Co.

Telephone switchboards and instruments were supplied by the Sterling Telephone & Electric Co., acting as sub-contractors to the Westminster Engineering Co., by whom they were erected and connected.

We are indebted to Messrs. Kennedy & Jenkin for the information contained in this article.

RAPID METHODS FOR PRODUCING ELECTROTYPES.

By SHERARD COWPER-COLES.

(*Continued from Vol. 58, page 1061.*)

Class 1.—*Electrolyte Circulated and Agitated.*—Fig. 20 shows a type of apparatus in which the electrolyte is both circulated and agitated. A is the suction pipe, and C the

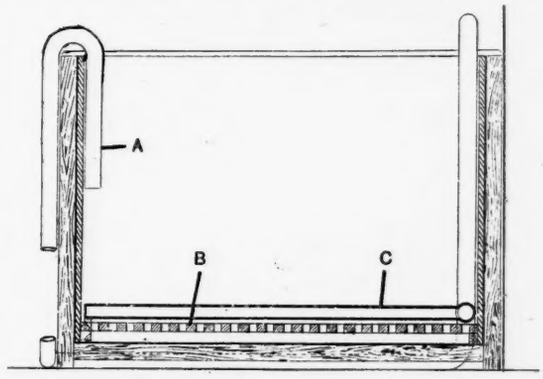


Fig. 20.—Hopkinson and Appleton's Apparatus.

perforated distributing pipe, the solution being circulated by means of a pump. A double bottom is provided, B, in which the sediment may settle. This apparatus was patented in 1888 by Hopkinson and Appleton.

An improved type of this class of apparatus is shown in fig. 21 ; it is claimed for this apparatus that copper shells

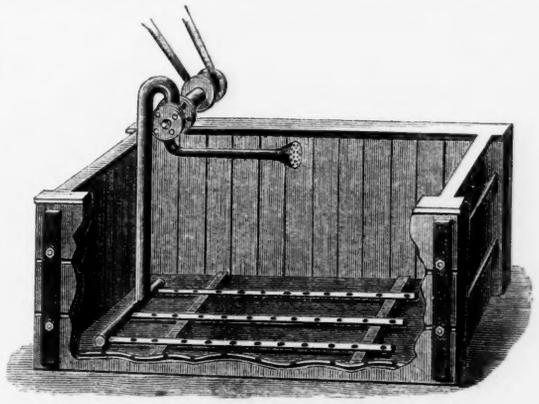


Fig. 21.—Collis's Agitator.

can be grown at the following rate :—The voltage being 4½ at the terminals of the dynamo, and the current density 10 amperes per sq. ft. (1·1 amperes per square decimetre) of shell to be deposited, a thickness of about ·002 in. can be deposited in four hours. The composition of the electrolyte recommended by the makers of this apparatus is 2 lb. (907·2 grms.) of sulphate of copper and 2 oz. (56·7 grms.) of sulphuric acid to every gallon (4·54 litres) of water.

Fig. 22 shows Canning's apparatus, which consists of a wooden trough A, placed at the bottom of the vat B, into which a wooden plunger C is forced by means of a lever

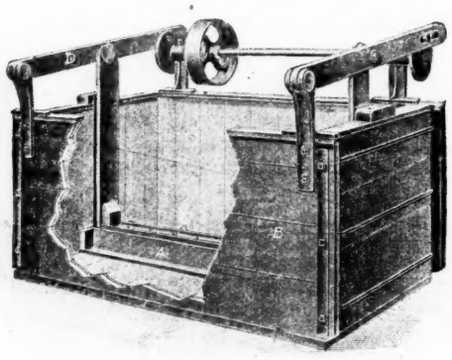


Fig. 22.—Canning's Agitator.

arm. The plunger C is provided with a number of holes. As the lever arm lifts the plunger, the solution fills the trough A, and as the plunger C is forced into the trough, the solution is forced up through the holes. The disadvantages of such an arrangement are that any impurities are kept in suspension and the circulation is too local.

Class 2.—Electrolyte Circulated only.—Fig. 23 represents an apparatus in which the electrolyte is circulated only; it is constructed by the Ostrander Seymour Co. The chief

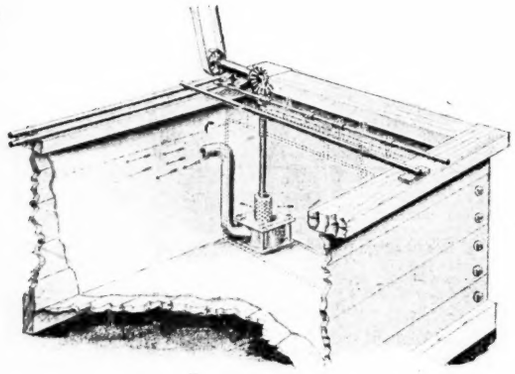


Fig. 23.—Ostrander Seymour Circulator.

mechanical disadvantages of such an arrangement are that all the working parts are in the solution, and are not readily accessible.

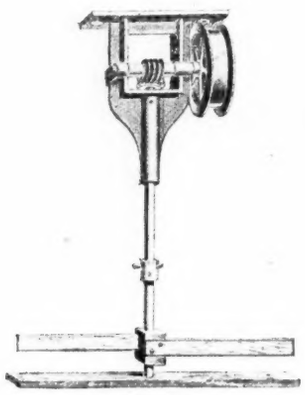


Fig. 24

Class 3.—Electrolyte Agitated only.—Fig. 24 represents a mechanical agitator which is placed in the electrolyte to be agitated, and driven by means of a belt or motor; this arrangement does not ensure a good circulation between the electrodes.

Figs. 25 and 26 show an apparatus for agitating the electrolyte by means of wood stirrers, or arms, actuated by

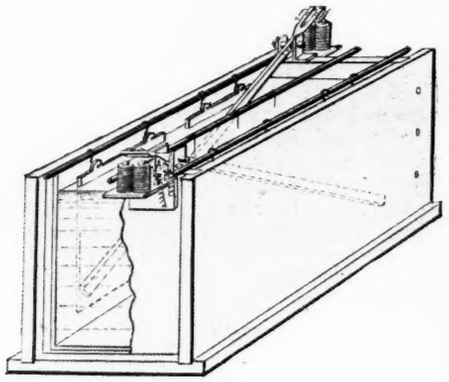


Fig. 25.—Electrical Agitator.

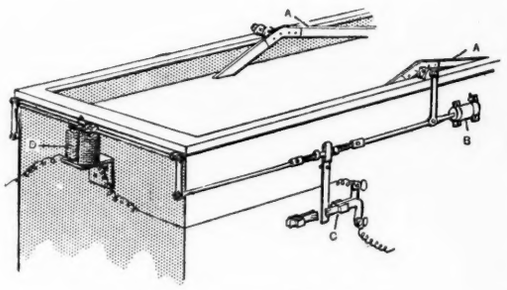


Fig. 26.—Electrical Stirrer.

electro-magnets. The motion is obtained from an armature (fig. 26) operated by an electro-magnet with cranks and connecting rod. The stirrers, A, are so weighted that when

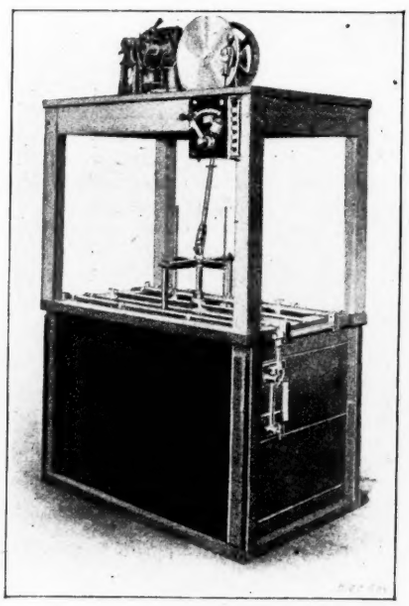


Fig. 27.—Boissier's Apparatus.

at rest, one arm, viz., the one farthest from the magnet makes an angle of about 15° with the perpendicular, so that the armature is about $\frac{3}{8}$ in. (1 cm.) above the poles of the

magnet. The current being switched on, the armature is pulled down, and the stirrer moved about its centre, lifting the weighted arm and sinking the other. In doing this, the stops on the connecting rod act on the switch C, which breaks the contact, and remains held by the stop, and the circuit is broken. The circuit being broken, the weighted arm of the stirrer gradually sinks until the pressure of the spring is sufficient to overcome the friction which holds the switch in the stop, when the contact is again made. The

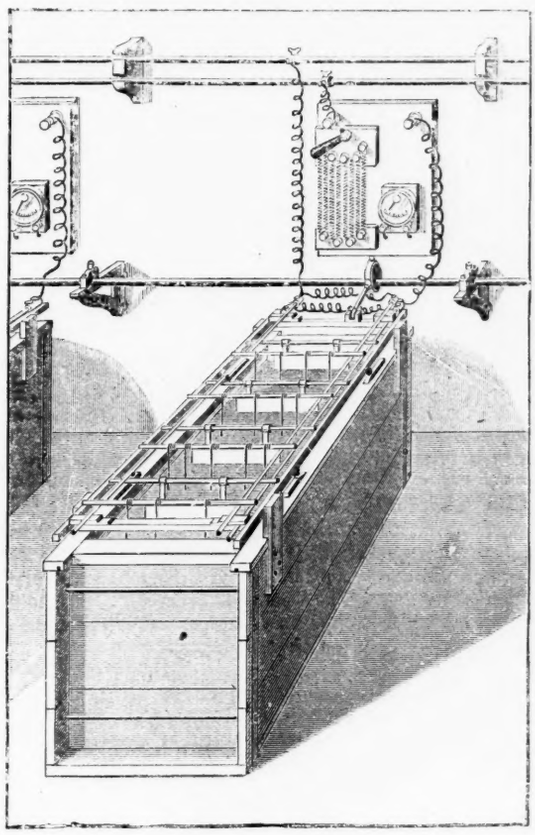


Fig. 28.—Rocking Frame.

stops are adjustable on the connecting rod, so that the time of make and break can be easily adjusted. To steady the motion, and vary the number of strokes per minute, a dash-pot B, with an adjustable tap, is used, so that the stirrer is quickly raised and falls slowly, dependent on the size of opening of the cock.

Fig. 27 is Boissier's arrangement for agitating the electrolyte. Stirrers are placed between the electrodes, which

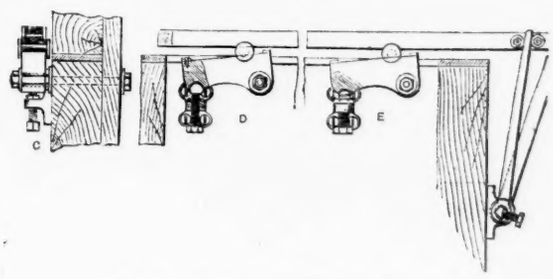


Fig. 29.—Details of Rocking Frame.

are driven through the gearing placed over the vat, by an electric motor.

Class 4.—Electrodes Moved.—The arrangement usually employed for moving the electrodes, or the anodes only, or cathodes only, consists of a rocking frame, which is given a horizontal and vertical motion, by causing the frame to move on inclined planes, as shown in fig. 28. The construction of a useful type of adjustable inclined plane or roller path is shown in detail in fig. 29.

Fig. 30 shows an electrotyping depositing vat, arranged for working by the Englehard process. The anodes employed are about 7 in. wide × 1½ in. thick, the length

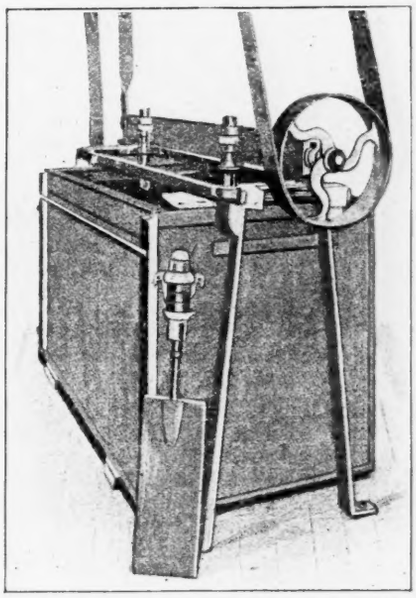


Fig. 30.—Englehard's Apparatus.

varying with the nature of the work. The anodes are mounted on spindles, as shown in fig. 30, and by suitable arrangements are rotated by power during the process of electro-deposition, the usual rate of rotation being about 50 r.p.m. The advantages claimed for this system are

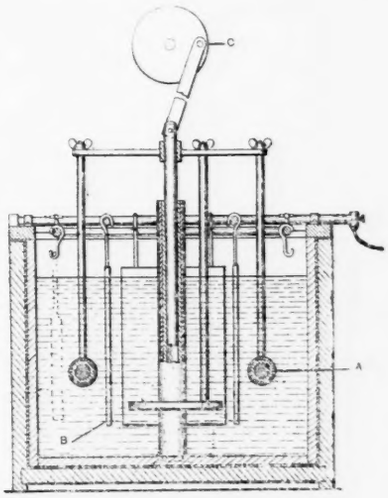
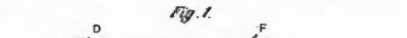


Fig. 31.—Boissier's Apparatus.

the anode keeps free from scale, and that a current of from 75 to 100 amperes per sq. ft. of the cathode can be employed. The pressure required is high, being 6 volts per vat.

Fig. 31 shows Boissier's apparatus. The framework A, when the apparatus is used for electrotyping, carries the cases, and is given a vertical reciprocating motion by means of the shaft C. Such an arrangement has the disadvantage that the motion has to be stopped when it is desired to remove a case, and the current reduced, otherwise the copper is burnt.

Illustration 32 (figs. 1 and 2), show an apparatus designed by the author for the rapid production of electrotypes, and is so arranged as to combine all the essential conditions for rapid and continuous working. The vat is divided into



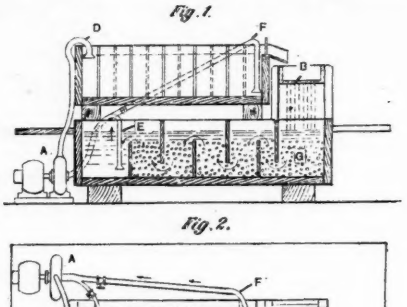


Fig. 32.

compartments, and the cases are suspended in the electrolyte on copper hooks and a cross rod, in close proximity to the anode G, and the electrolyte is caused to follow a zig-zag course in passing through the vat; it is then passed through a filter B, and conducted to a settling tank G, from which the filtered solution is reconducted through the vat, by means of the centrifugal pump A, the suction pipes F and E, and the delivery pipe D.

Another form of apparatus is shown in fig. 33, in which the anodes and cathodes are both revolved. The cases are mounted in conjunction with a perforated anode plate, on a rotatable carrier, so that the electrolyte is forced through the

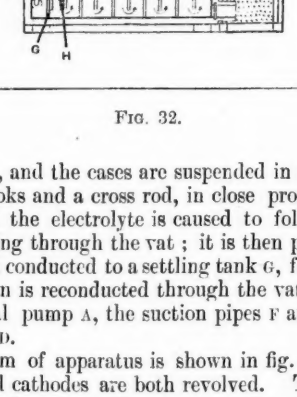


Fig. 33.

holes in the plate against the mould when rotated. The anodes and moulds are suspended from arms radiating from a hub rotated by means of a shaft and pulley, the arms being steadied by means of rods; the tank is provided with a central inlet B, and an overflow G.

(*To be concluded.*)

Switzerland.—The balance-sheet of La Société Franco-Suisse pour l'Industrie Electrique, for the last financial year shows a net profit of £35,100. A dividend of 3 per cent. is being declared, and £3,200 added to reserve.

THE COLLIERY EXHIBITION.

(*Continued from Vol. 58, page 988.*)

Messrs. Head, Wrightson & Co., Ltd., also had an excellent exhibit of colliery conveying and coal-shipping machinery. A new conveyor, "the 'Marcus' propulsion trough conveyor," was shown in operation. This consists of a trough mounted upon wheels or rollers, which is given a slow forward and quick return motion, by means of a patented arrangement of cranks coupled together by a drag link driving the trough through connecting rods. Its action is best illustrated by taking a piece of cardboard and laying upon it a coin or other light object. If now the cardboard be held in the hand and moved forward, the coin goes with it, but on jerking the hand back the cardboard returns, while the coin, so to speak, remains, and thus is made to occupy a new position on the cardboard in advance of the first position, and if this action be continued a few times, the coin quickly reaches the end of the piece of cardboard, and falls off. It is distinctly dissimilar to the well-known "Zimmer" or "Kreiss" vibrating conveyor, which was also shown at the Exhibition, and which gives a hopping motion to the material being conveyed. In both cases, however, serious abrasion takes place if the material is at all soft—as, for instance, some qualities of coal—and they are not *quite* noiseless.

The Stirling Boiler Co., Ltd., exhibited two working models illustrating the circulation of water in the tubes and drums, and several sectional drawings showing the construction of their boilers. One drawing showed their independently fired superheater, which is practically one of their five-drum type boilers, with the front bank filled with water, and generating from 7 to 12 per cent. of the steam passing through the superheater. On this stand was also shown an improved Mahler type bomb fuel calorimeter by the Bryan Donkin Co., Ltd. The bomb is of special strong metal, gold-plated inside to prevent corrosion, and in this is placed the sample of fuel to be tested upon a small platinum crucible, after which a strong cover is bolted on, and the bomb is filled with oxygen under pressure. It is then placed in the calorimeter, which is filled with water at a known temperature, which is constantly stirred by vanes, either worked by hand or by a small motor. The sample is then exploded by electricity, and the rise in the temperature of the water—which is constantly being stirred—is carefully noted. It is a strong and beautifully made instrument, and the calorific value can easily be obtained to within ·5 per cent., and by careful experiments the error will not exceed ·3 per cent.

Messrs. John Thompson showed a section of their dished end Lancashire boiler, 9 ft. 3 in. in diameter, by 30 ft. long, for a pressure of 150 lb. The special feature of this boiler is that no stays are required, and the flue tubes can be removed without disturbing the end plates. The ends are $1\frac{1}{8}$ in. and the plates $\frac{11}{16}$ in. thick. A model was also shown of the Dürr water-tube boiler.

An interesting exhibit was that of Kramos, Ltd., who showed a working model lift controlled by their patent automatic push button and switch-in-car controller. By this means the car either in ascending or descending can be directed to any floor, on reaching which it stops automatically. A special feature was the Kramos patent resistance used in connection with the starting switch, which consists of several small units of cylindrical form, about $1\frac{3}{4}$ in. long by $1\frac{3}{4}$ in. in diameter. The resistance is arranged in parallel with the armature in large steps, which are again sub-divided in such a manner that the resistance instead of being switched in from one step to another with fairly large values, is inserted in extremely small values, gradually rising until a step is reached equal to, say, one step on an ordinary starter; between this step and the next, another set of small value resistances are in parallel, which are gradually cut out until the next step is reached, and so on, thus enabling the lift to be started easily and smoothly without the least jerk and with a steady increase in the speed of the motor. The resistance units consist of special powdered graphite divided into three sections of varying resistance, so arranged that the current must traverse the whole section of the cylinder instead of, as

might occur, only a portion near the centre. As an instance of what energy can be dissipated, we may mention that four of these cylinders in series, occupying a space 7 in. × 1¾ in., are practically equal to 1 H.P. Compared to spiral wire resistance coils, they are vastly superior, if only for the feature of requiring small space. They are non-inductive, and therefore suitable for alternating currents. One of these lifts has recently been installed for the Wolseley Motor-Car Co., Ltd., to deal with a load of 2 tons, and for five floors. Other exhibits included several examples of electric drilling machines and a magnetic drilling pillar, which by the mere pressing of a knob firmly attached itself to the plate to be drilled. These machines were well finished, and judging by the work we saw done by them, are very efficient. They are entirely British made, and we were asked to state that these machines are the same as sold by the Electrical Ordnance and Accessories Co., Ltd., who have the right to manufacture from Kramos, Ltd. Another item on this stand was the Kramos flexible shaft.

Kynoch, Ltd., exhibited a gas engine and suction plant, which was driving a dynamo generating current for lighting the stand by means of the "mineralozone flame arc lamp," supplied by Messrs. I. & H. Grevener, Eldon Street, London, E.C. The full-light effect of these lamps could not, of course, be judged, as they were burning in daylight: but they appeared to give a very steady and excellent light.

The Lahmeyer Electrical Co., Ltd., showed a Karlick speed-indicator for measuring and recording the rope speed in winding shafts. We were informed that this instrument has been largely adopted by up-to-date collieries, and in some cases has been made compulsory at Continental collieries. It was no doubt a beautifully-constructed instrument, but, in our opinion, more fitted for a scientific laboratory than a colliery winding engine house. A much more practical and useful apparatus was a signalling set, which consists of a pillar placed on the heapstead in charge of the "banksman," and by which means he can practically control the speed of the engine quite independently of the engineman. Thus if men are to ride upon the cage, the banksman turns a pointer to the indicator marked to this effect, which signals to the engineman and at the same moment lights a coloured lamp. An electrical arrangement in connection with the pillar places a stop on the controller so that the engineman can only move his handle over sufficiently to give the permitted speed to the engine. Another point on the indicator marked "stop," prevents the engineman moving the engine at all. A depth indicator and controlling gear for a large winding engine was also shown. The former consisted of two screws worked from the winding drum shaft, which caused large nuts fitted with tappets to move up or down. These tappets strike levers at the top or bottom of the indicator, which are connected to the controller handle and force it back to the "off" position if this should not be done by the engineman in time to bring the cages to a standstill at the right moment. Again, whilst no doubt this gear was interesting and very well made and finished, it appeared to be complicated, and we venture to think that the same end could be obtained by simpler apparatus; further, we question very much whether the retardation of the cages, with this gear, would not occupy too long a period to suit winding operations in this country: but, no doubt, this could be modified to suit circumstances.

Another exhibit included a very strong and even heavily built controller and resistance boxes, the controller being of the drum type, with oil-filled case, and the resistance boxes also oil filled and cooled by water circulating through pipe coils. Another interesting exhibit was a 50-H.P. fire-damp-proof three-phase induction motor. This is so constructed that any air containing fire-damp passing through the machine is so split up into very thin laminations that it is rendered harmless.

Coal-cutting machinery was largely represented, six firms exhibiting their latest type electric coal-cutters, and it was interesting to note that the majority of the machines were on skids.

Messrs. Scott & Mountain exhibited a new three-phase disk-type coal-cutter, the chief feature of which is that the motor is vertical instead of horizontal. A great difficulty hitherto has been that the small height of the seam in which these motors are to work, necessitated the power of the motor to be very much restricted in order to keep the dimensions of the latter consistent with the requirements. The same difficulty does not arise in regard to the width of the machine, though of course there is a limit to this, but considerably more margin is allowed the designer, and by placing the motor in this position, a powerful machine can be constructed to meet the required conditions as to height. The rotor revolves upon ball bearings, the shaft being provided with a small pinion wheel which gears into a large spur wheel, to the vertical shaft of which is fitted the bevel gearing which drives the disk. Another

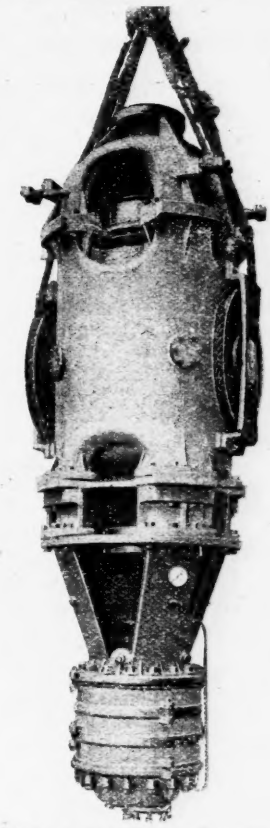


Fig. 3.—Scott & Mountain Electric Sinking Pump for Kent Collieries.

point of interest about this machine is that the disk centre is provided with a roller bearing. A new coal-cutter starting switch was also interesting, both as regards the mechanism for cutting out resistance, which is done by a number of small chopper type switches, which are switched in one after another by merely turning the starting handle, and as regards the resistance itself, which is formed by a number

Fig. 4.—Mavor & Coulson Three-Phase Coal-Cutter.

of small units, consisting of a small coil of wire embedded in a special clay and burnt practically as hard as brick, upon a short steel bar. One end of this bar projects, and not only forms one terminal, but is also the means by which it is held in place by merely pushing it into a socket. A photograph was also shown of a new sinking pump for the Kent Collieries, and which is shown in fig. 3. The motor is vertical and fully enclosed, the centrifugal pump being suspended below by four rectangular-shaped pipes. The water passes through these and up through the outer casing surrounding the motor, which is thus water cooled, and out at the delivery pipe on the top. The whole pump is suspended by ropes, which are passed round the two pulleys to which the slings are shown attached, and by these is raised or lowered in the shaft as required. Other

and £3,200 added to reserve.

items on this firm's stand included their now well-known haulage and pumping machinery and enclosed high-speed engines.

Messrs. Mavor & Coulson showed their bar type "pick-quick" machines driven by either compressed air or electricity, their latest machine being a small coal-cutter fitted with a three-phase motor and a 4 ft. 6 in. bar. The makers claim that it is the smallest machine made. The motor is of 15 h.p., and as will be seen in fig. 4, the whole machine is very compact and mounted upon skids.

(*To be continued.*)

INTERFERENCE IN WIRELESS TELEGRAPHY AND THE INTERNATIONAL TELEGRAPH CONFERENCE.

By R. A. FESSENDEN.

The present note deals with the subject of selective reception of wireless telegraph messages under the following headings :—

1. Misconceptions and misinformation.
2. Selectivity by tuning.
3. Selectivity by balance methods.
4. Results actually obtained.
   (*a*) As shown by official reports.
   (*b*) As shown by verified tests.
5. Directed messages and unpublished methods.
6. Suggested method of international working.

Misconceptions and Misinformation.

A great many misleading statements have been published as to the ability of wireless stations to operate without interfering with each other, but so far as I know no reliable and detailed information in regard to this matter has as yet appeared. I propose to set forth the facts plainly, to substantiate them by official reports of tests, to explain fully by diagrams the conditions of the tests, and to suggest a practical scheme of international working.

Tests on cutting out interference may be divided into two classes, pseudo-tests and tests properly so-called. A pseudo-test is a test made under conditions which have no bearing on the practical question, and in which practical working obstacles have been carefully eliminated. A test properly so-called is one made under practical conditions.

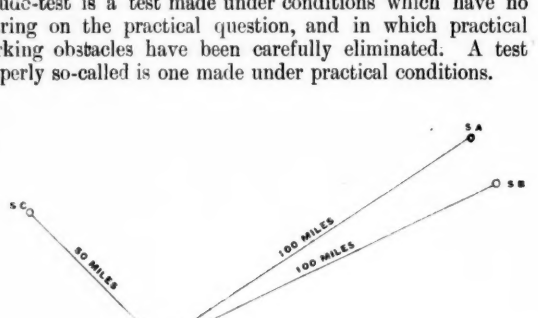


Fig. 1.

Pseudo-Tests—Figs. 1 and 2 illustrate methods of making pseudo-tests. In fig. 1, R A is the receiving station, and S A, S B, S C and S D are sending stations.

Since S A, S B and S C do not differ greatly in distance, there is, of course, no difficulty at all in the operator at R A receiving messages from any one of these stations by tuning out the others, or even receiving messages from all three simultaneously on three differently tuned branched circuits, or three different aerials. For example, if the stations S A, S B and S C differ about 5 per cent. in tune from each other, when the station at R A is tuned for any one of them, the signals from the others will be weakened to such an extent that they will either be entirely inaudible or else so faint that they do not interfere.

Should it be desired for the purpose of the pseudo-test to use a near-by station, as, for example, S D, only five miles from the receiving station, all that is necessary is to weaken the strength of the signal emitted by S D in the ratio of the inverse square of the distance, in which case S D can also be cut in and out. Of course, in practice S D might be sending *at full strength* to another station, S E, 100 miles away, but in making pseudo-tests things are not arranged that way.

Fig. 2 shows another form of pseudo-test, in which R A is the receiving station and S A and S B sending stations, S A and S B differing very widely in wave-length and S A having preferably a very much longer wave-length than S B.

In this case there is of course no difficulty in the station R A receiving from S A while S B is sending, as the difference in wave-length is so great. In addition, however, as a rule S B is also made much weaker in power than S A.

Such tests, of course, have no bearing upon the real question as to whether wireless telegraph stations can work selectively.

Tests properly so-called.—Fig. 3 shows the method of conducting a proper test for selectivity. Here R A is a receiving station, S A is a sending station 100 miles away from the receiving station R A, and D A and D B are disturbing or interfering stations distant one mile from R A, of equal power with S A and differing only a few per cent. in wave-length from S A.

In a test made under these conditions, the ability of R A to receive messages from S A while D A and D B are sending, is a true test of the ability of R A to cut out interference.

Selectivity by Tuning.

It is to be regretted that a number of statements about selectivity have been published which were entirely incorrect. For example, the statement has been frequently made that disturbing stations can be cut out by tuning. These statements were at first accepted by the general public and also by many engineers, but when the fact became known that interference still caused trouble, the previous attitude of unquestioning belief changed to one of complete incredulity. When a certain company requested of the United States Navy Department, in 1902, an opportunity to show that interference could be cut out, it was informed by the Navy Department that nearly every other company was claiming the same thing, and that in every case where the matter had been investigated, it had been found that interference could not be cut out, and that the department attached no importance to statements of that kind.

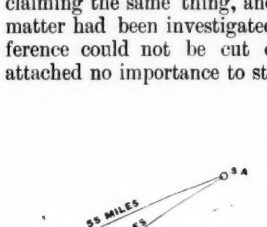


Fig. 2.

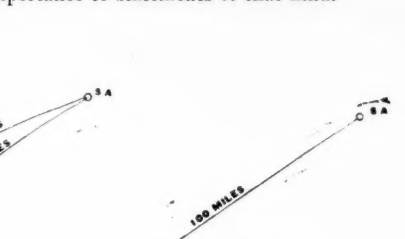


Fig. 3.

While the writer considers that the action taken by various governments in regard to wireless telegraph working has been of a most oppressive and unfair character, and calculated to throttle an important and rapidly developing art, yet, at the same time, he is free to admit that the wireless companies (considered as a whole, the innocent with the guilty) have only themselves to blame for the situation. A frank statement of the difficulties to be overcome would probably have resulted in due consideration being shown to a new industry, while, as it is, the facts have been so distorted, and so many unveracious statements made, that it is only natural that the various governments should have formed the erroneous idea that all the statements made in regard to cutting out interference were equally unreliable, and that they should have arrived at

the conclusion that government control was not only advisable but necessary.

As a matter of fact, as the writer pointed out some years ago (*Electrical World*, 1904, page 949), selectivity can never be accomplished by tuning. This may be shown as follows :—

The amplitude of the oscillations in the resonant circuit cannot increase indefinitely, for when the point is reached at which the losses in the resonant circuit become equal to the energy received by the resonant circuit, no further increase is possible. Assume that the resonant receiving circuit has an efficiency of 99 per cent., *i.e.*, that it only wastes 1 per cent. of the energy which it stores up. This, it will be admitted, is a pretty high efficiency. Then, in this case, the strength of the signals at the resonant point will be 100 times the strength away from the resonant point. If, therefore, in fig. 1, R A is a receiving station tuned to the sending station S C, and S D is another sending station of a different tune, but of equal power with S C, then since S D is 10 times as near R A as S C is, and the radiation varies as the inverse square of the distance, the amount of radiation arriving at the station R A from the station S D will be 100 times greater than that arriving at the station R A from station S C. Hence, although R A is resonant to S C, and S C is not resonant to S D, the strength of the signals received at R A will be the same whether they come from S D or S C, and hence the station S D would interfere with the reception of signals from S C.

Hence we see that even with a resonant receiving circuit having an efficiency of 99 per cent., an interfering station within 10 per cent. of the distance of the sending station will prevent the receipt of messages.

This is approximately what is found in practice ; in fact, in the U.S. Navy tests, which will be referred to later on, it was found that the interfering station prevented the reception of messages by all systems tested which depended upon tuning for selectivity, when within 20 per cent. of the distance of the sending station.

Another "blessed word" which has been used in this connection is "loose coupling." Ten or 15 years ago, when the question of multiplex working by alternating currents was before the profession, the question of loose-coupled circuits came in for a good deal of discussion. At that time Stokes's paper on "Fluorescence," and J. J. Thomson's "Recent Researches in Electricity," chapter 5, were the chief works of reference, the latter writer being the first to point out the method of annulling the effect of a linked circuit by increasing its self-induction. (*Ibid*, page 390.) At first loosely-coupled circuits were quite generally used in experiments on electrical oscillations, but those familiar with the laws of optics soon saw that in most cases it was advisable to use tightly-coupled circuits. Within the last few years, however, a number of workers not familiar with the subject, have brought forward loosely-coupled circuits as being something new.

The electrical explanation of the phenomena of coupled-circuits is comparatively simple. Let A be an oscillating circuit having a natural frequency X, and let the circuit B, whose natural period is also X, be brought into inductive relation with the circuit A, so that B forms a secondary of which A is the primary. From the usual formulæ it can be shown that the currents in the two circuits are not in the same phase This being the case, the current in each circuit can be split up into two components, two of these components being in opposite phase to each other, and the other components being in the same phase. The two circuits A and B will, therefore, have two values of their coefficients of self-induction according as we consider components in phase with each other or opposed to each other. There will, therefore, in general be two natural frequencies for each of the circuits, and what these frequencies are can be easily calculated by this method.

There are two cases in which the two circuits have but a single frequency. The first case is when the coupling is infinitely tight, *i.e.*, there is no magnetic leakage between circuit A and circuit B, and hence the induced exciting currents have their neutral points at the same instant of time. The second case is where the coupling is infinitely loose.

Unless the coupling between the two circuits is either infinitely tight or infinitely loose, there will always be two oscillations of different frequencies. The advocates of loose coupling have grasped the fact that by reducing the strength of the coupling between the two circuits, the frequencies of the two oscillations may be made to approach each other, but they have not grasped the fact that as the strength of the coupling is weakened and the frequencies made to approach each other, the transference of energy diminishes in a still greater degree, and that when finally the two frequencies are made to coincide, the primary circuit transfers no energy to the secondary circuit. This may easily be seen mathematically, for it may be shown that the same terms which define the strength of the coupling also enter into the expression for the transference of energy between the two circuits. The writer experimentally demonstrated this in 1899, and Prof. Pierce, of Harvard, recently showed the same thing.

Fig. 4 shows a curve taken from Prof. Pierce's paper. The thick line shows the resonant curve for a coefficient of coupling ·30, and the dotted line the resonant curve for a

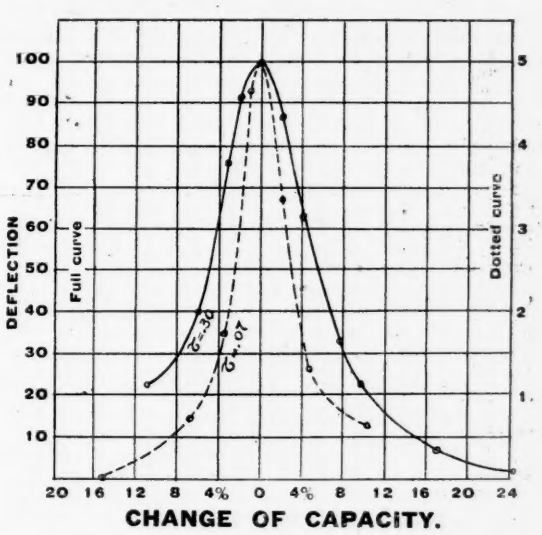


Fig. 4.

coefficient of coupling ·07. It is to be noted that the scale of the dotted curve is 20 times as great as the scale of the solid curve.

With reference to these curves, Prof. Pierce states as follows :—

> Experiment X thus confirms the theoretical deduction that with decrease of the coefficient of coupling the sharpness of resonance is increased. The gain in sharpness of resonance is, however, paid for by a loss of energy ; for with constant sending station, in order to improve the sharpness of resonance two-fold, it was necessary to change the coefficient of coupling at the receiving station to such an extent that the energy received was decreased twenty-fold. Of course, these particular numbers hold only when the receiving instrument has a very low resistance. In these experiments the resistance of the dynamometer was only 1·33 ohms. With a high resistance receiving instrument it is not possible to obtain resonance as sharp as that here found, and the effect in sharpness of resonance produced by diminishing r would be less than in the case under observation. I have been taking some data with the electrolytic and michrophonic receivers, but the experiments are not yet ready for presentation.

It will be seen, therefore, that it is much better to use a strong coupling with the balance method to be described in a later section, than it is to use a loose coupling.

Another vital point which the advocates of loose coupling have not grasped, is the fact that even with a very small coefficient of coupling the difference between the frequencies will still be much too great for practical working. With the present methods of cutting out interference, a difference of frequency of 1½ per cent. is a large difference, and in the writer's work between Scotland and Massachusetts a difference of ¼ per cent. in the frequency was sufficient to cut down the intensity of the signals more than 20 times. If a circuit were coupled up so loosely that the maxima of both frequencies differed by less than ¼ per cent., the amount of energy transmitted or received would be very little indeed.

Both Prof. Fleming and myself prefer to use a strongly-coupled circuit for most work. Prof. Fleming prefers to use a circuit coupled so strongly that he gets the use of the third harmonic. I prefer to use a circuit coupled so strongly as only to give a single frequency, or else to use one of medium strength of coupling and to arrange the receiving apparatus so that it takes in both frequencies.

All this might have been seen at once by considering Prevost's Law of Exchanges, but it is a curious fact that with one or two eminent exceptions most experimenters in wireless telegraphy seem to be ignorant of the elementary laws governing the propagation of wave disturbances.

(*To be continued.*)

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,813A/05. "Improvements in or relating to the electrolysis of metallic compounds." E. A. ASHCROFT. Date applied for under Rule 5 of the Patents Rules, 1905, December 22nd, 1905.) June 22nd.

13,685. "Improved electric cut-out and distribution box." G. SCOCCIMARRO June 18th.

13,897. "Improvements in methods of generating electricity." B. F. BADEN-POWELL. June 18th.

13,903. "Improved means of working and control for petrol-electric cars and electric cars." W. A. STEVENS. June 18th. (Complete.)

13,928. "Improvement in electric meters of the motor type." J. WETTER. (A. May, Germany.) June 18th.

13,929. "Improvements in the method of and in means for effecting ignition in internal combustion motors." W. A. TRIER. June 18th.

13,946. "Improvements in and relating to induction coils." S. H. SAUVE and J. H. ROBBINS. June 18th. (Complete.)

13,949. "Improvements relating to electric furnaces." S. Z. DE FERRANTI. June 18th.

13,955. "Electrically operated self-levelling marine tables." C. W. LASKAY. June 18th. (Complete.)

13,956. "Improved metallic filament for electric glow lamps and method of treating same." P. M. JUSTICE. (Deutsche Gasgluhlicht Akt.-Ges. (Auerges), Germany.) June 18th. (Complete.)

13,965. "Improvements relating to electric furnaces." S. Z. DE FERRANTI. June 18th.

13,969. "Improvements in or relating to temporarily-acting make-and-break devices for electric contact apparatus." J. V. WENGELIN. June 18th. (Complete.)

13,972. "Improvements in the electro-deposition of copper." S. O. COWPER-COLES. June 18th.

13,978. "Improvements in means for applying pressure to commutator brushes." THE MORGAN CRUCIBLE CO., LTD., and J. E. GRANT. June 18th.

13,985. "Improvements in electricity meters." CHAMBERLAIN & HOOKHAM, LTD., and S. H. HOLDEN. June 19th.

13,995. "Improvements in or relating to a new type of electric motor." R. J. CROWLEY and L. G. CAUNTER. June 19th.

14,006. "Improvement in electric switches." J. H. TUCKER. June 19th.

14,041. "Improvements in and connected with the suspension of electric and other lamps and other articles." A. WUNDERLICH and G. A. HUGHES. June 19th.

14,058. "Improvements in switching devices for electric circuits." M. KALLMANN. June 19th.

14,060. "Improvements in and relating to Hertzian wave-telegraphy." A. MUIRHEAD. June 19th. (Complete.)

14,073. "Improvements in controller regulators." J. B. DURKIN. (Date applied for under Patents Act, 1901, January 8th, 1906, being date of application in United States.) June 19th. (Complete.)

14,085. "Improvements in and relating to electric switch controlling mechanism. THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 19th.

14,090. "Harmonic signalling for party lines." W. H. WEATLEY. (The firm of C. Lorenz, Germany.) June 19th. (Complete.)

14,163. "Improvements in or relating to electric traction systems." T. L. JOHNSON. June 20th. (Complete.)

14,165. "Improvements relating to the brushes of electric motors." R. B. RANSFORD (Compagnie Parisienne des Voitures Electriques (procedes Krieger) France.) June 20th. (Complete.)

14,268. "Improvements in statical machines particularly for lighting gas, ether, benzoline, and the like." F. NEHMER. June 21st.

14,302. "Magnetic mirror." D. CLIFTON. June 22nd.

14,304. "Improvements in and relating to electric organs." A. A. MUGNIER. June 22nd.

14,347. "Improvements in electricity meters." W. M. MORDEY and G. C. FRICKER. June 22nd.

14,359. "Improvements in and relating to electromatically-operating apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 22nd.

14,360. "Improvements in electric distribution systems and apparatus therefor." THE BRITISH THOMSON-HOUSTON CO., LTD., and W. F. DAWSON. June 22nd.

14,361. "Improvements in machines for making incandescent electric lamps and the like." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) June 22nd.

14,365. "Improvements in and relating to electrical switch and like gear." W. ROBERTS. (J. Roberts, South Africa.) June 22nd.

14,373. "Improvements in fuses for projectiles." H. P. MERRIMAN. (Date applied for under Patents Act, 1901, June 23rd, 1905, being date of application in United States.) June 23rd. (Complete.)

14,390. "Improvements in or connected with the detection of electrical oscillations." L. H. WALTER. June 23rd.

14,403. "Improvements in brackets for suspending aerial cables." J. GRAY. June 23rd. (Complete.)

14,420. "Improvements in electrical resistance furnaces." E. CORNELIUS and L. FEHN. June 23rd.

14,425. "Improvements relating to the manufacture of filaments for use in electric incandescent lamps." W. E. SANDER. June 23rd.

14,433. "Improvements in the regulation of continuous current motors." C. H. ILES and W. ARMISTEAD. June 23rd. (Complete.)

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1905.

INCANDESCENT ELECTRIC LAMPS. L. Sunderland and G. C. Pillinger. 6,456. March 27th.

SHIPS' COMPASSES. H. H. Lake. (H. P. Arbecam.) 10,467. May 18th.

APPARATUS FOR STARTING AND FOR REGULATING THE SPEED OF COMPENSATED SINGLE-PHASE ELECTRIC MOTORS. E. Arnold and J. L. La Cour. 10,850. May 24th. (Date applied for under International Convention, May 24th, 1904.)

SYSTEMS OF ELECTRIC MOTOR CONTROL AND APPARATUS THEREFOR. British Thomson-Houston Co. (General Electric Co.) 10,893. May 24th.

ACCUMULATOR PLATES. A. Schanschieff. 11,654. June 3rd.

DYNAMO-ELECTRIC MACHINERY. The Hon. C. A. Parsons and A. Flint. 13,107. June 24th.

DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co.) 13,379. June 29th.

ELECTRICAL JUNCTION BOXES, SWITCH BOXES, CEILING ROSE BOXES AND THE LIKE. J. W. Brooks and A. E. Read. 13,918. July 6th.

ELECTRICALLY CONTROLLED VARIABLE SPEED GEAR FOR USE IN CONNECTION WITH ELECTRO-MOTORS. H. V. James. 15,002. July 20th.

ELECTRICAL IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES. Electric Ignition Co. and F. H. Hall. 17,896. September 5th.

ELECTRICAL SECONDARY BATTERIES FOR PROPULSION. W. N. Caton. 19,853. October 2nd.

TRANSMISSION OF INTELLIGENCE WITH THE AID OF ELECTRIC ENERGY. I. Kitsee. 20,548. October 11th.

ELECTRIC SIGNALLING APPARATUS FOR HOUSE AND LIKE USE. A. F. Street. 25,288. December 5th.

MEANS FOR PREVENTING THE "LIVE WIRES" OF ELECTRIC TRAMWAYS FROM DESCENDING TO THE COMMON DANGER OF PEDESTRIANS AND OTHERS WHEN BROKEN OR SEVERED. S. Sims. 25,636. December 9th.

MEANS FOR AUTOMATICALLY CONNECTING UP THE SUBSCRIBERS OF TELEPHONE EXCHANGES TO EACH OTHER. J. Peticky, I. Cizek and F. Suchanek. 25,826. December 21st.

ELECTRICAL MEASURING INSTRUMENTS. H. Hertzberg, W. P. Snyder, J. H. Griffin and H. I. Bernhard. 10,959. May 25th.

SYSTEMS OF ELECTRIC DISTRIBUTION BY MEANS OF RECTIFIED ALTERNATING ELECTRIC CURRENT AND APPARATUS THEREFOR. British Thomson-Houston Co. (General Electric Co.) 11,627. June 2nd.

AUTOMATICALLY EQUALISING THE LOAD IN ALTERNATING ELECTRIC CURRENT CIRCUITS. R. Braun. 11,821. June 6th.

MAGNETO-ELECTRIC DUMB-BELL. J. Moores. 12,399. June 15th.

SYSTEM OF ELECTRIC CONTROL AND APPARATUS THEREFOR. British Thomson-Houston Co. (General Electric Co.) 13,380. June 29th.

VAPOUR-ELECTRIC RECTIFIERS. British Thomson-Houston Co. (General Electric Co.) 14,715. July 18th.

ELECTRIC TELEGRAPH APPARATUS FOR TRANSMITTING INDICATIONS CORRESPONDING TO A TRANSMITTER HANDLE. J. Robinson. 16,083. August 5th.

STORAGE BATTERIES. G. K. Hartung. 16,570. August 15th.

BRACKET FOR CARRYING A LIGHT ON THE HEAD AND ELECTRICAL FITTINGS FOR USE THEREWITH. O. Millauro. 18,673. September 15th.

AUTOMATIC STARTING RESISTANCE FOR ELECTRICAL MOTORS. E. Bolton. 21,583. October 24th.

CONDUCTORS FOR THE ELECTRIC LIGHTING OF MINERS' SAFETY LAMPS. D. Thomas and W. Phillips. 26,109. December 15th.

SECONDARY OR STORAGE BATTERIES. A. J. Boult. (E. V. Stebbins.) 26,876. December 23rd.

ELECTRIC FUSES. A. Schwartz. 4,237. March 1st.

ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co. (General Electric Co.) 11,537. June 2nd.

DYNAMO-ELECTRIC MACHINES. G. (known as A.) Berry. 11,600. June 2nd.

ELECTRICAL RELAYS FOR RAILWAY TRACK CIRCUITS AND TELEGRAPH PURPOSES. W. R. Sykes. 11,899. June 7th.

ELECTRIC SWITCHES. British Thomson-Houston Co. and E. B. Wedmore. 11,970. June 7th.

ELECTRIC COUPLINGS. British Thomson-Houston Co. and E. B. Wedmore. 11,970A. June 7th. (Date applied for under Rule 5 of Patents Rules 1905, June 7th, 1905.)

METHOD OF OPERATING MERCURY VAPOUR LAMPS. O. D. Lucas. 12,087. June 9th.

ELECTRIC CABLES OR CONDUCTORS. H. Edmunds and P. Dawson. 12,171. June 10th.

1906.

SWITCHES OR CIRCUIT BREAKERS FOR ELECTRICALLY PROPELLED VEHICLES OR TRAINS. W. B. Potter. 4,710. February 26th.

DIRECT CURRENT ELECTRIC MOTORS. Soc. Anon. Westinghouse and R. Brun. 4,795. February 27th. (Date applied for under International Convention, March 1st, 1905.)

CONTROLLING DEVICES FOR ELECTRIC MOTORS APPLICABLE TO THE MOTORS OF ELEVATORS OR LIFTS AND THE LIKE. Otis Elevator Co. (Otis Elevator Co.) 5,003. March 1st.

MEANS FOR OPERATING THE CONTACT LEVER WHICH PRODUCES THE BREAK SPARK IN MAGNETO-IGNITION APPARATUS. A. F. White. 1,091. January 15th.

MEANS FOR CONTROLLING THE CONTACT LEVER OF ELECTRICAL IGNITING APPARATUS FOR EXPLOSION MOTORS. E. Eisemann. 1,099. January 15th.

METALLIC VAPOUR ARC LAMPS. B. E. D. Kilburn. (Phönix Elektrotechnische Ges.) 2,603. February 2nd.

ELECTRIC SWITCHES AND CONTROLLING MECHANISM THEREFOR. J. S. Pevear. 4,720. February 27th. (Date applied for under International Convention, February 27th, 1905.)

ELECTRIC LAMP HEATING APPARATUS. A. B. Holmes. 5,092. March 2nd.

DEVICE FOR USE IN SUPPORTING ELECTRIC CABLES, PIPES, RODS, AND THE LIKE. F. Mitchell and F. Gunn. 7,332. March 27th.